

# Annual Water Quality Report

## BLACK BUTTE LAKE

Water Year 2001



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# **I DISCUSSION**

# **Black Butte Lake**

## **2001 Results**

The dissolved oxygen, water temperature, and pH profiles are shown on the attached figures in Section II. The lake's became relatively shallow being only 53 feet deep during the summer of 2001. This resulted in weak thermal stratification and the water temperature reached 62 degrees F at the lake's bottom in August. Dissolved oxygen depletion also occurred in the hypolimnion or bottom layer of the lake during the summer. The dissolved oxygen depletion indicate that organic decomposition is occurring at the bottom of Black Butte Lake. Because of the warm water and low dissolved oxygen in the summer, the use of Black Butte Lake as a cold water fishery is questionable. However, since the dissolved oxygen is relatively high on the surface, the lake may serve well as a warm water fishery.

The DO, temperature and pH profile changed very little from 2000. The summer phytoplankton biomass fluctuated from 1.5 mg/L in 1999 to 0.45 mg/L in 2000 to 1.8 mg/L in 2001. The Spring phytoplankton biomass is suitable to provide grazing for zooplankton, which in turn will feed young fish during the crucial post-hatching periods. This amount of phytoplankton biomass is not considered a problem but it should be noted that levels of phytoplankton will vary from year to year and will be monitored continuously to determine if eutrophication is occurring.

Eutrophication is the slow natural process in which a Lake moves from an oligotrophic condition to a mesotrophic condition and then to a eutrophic condition. Oligotrophic waters contains low concentrations of essential nutrients such as nitrogen, phosphorus and iron and therefore life forms are generally present in small numbers. Lake Tahoe and Crater Lake in Oregon are examples of oligotrophic waters. Natural input of nutrients from runoff results in a gradual increase of phytoplankton and higher life forms. This results in the transformation of oligotrophic waters into Mesotrophic waters which are characterized by the abundance of life forms at all levels. However, continued inflow of nutrients can further change the Mesotrophic waters into Eutrophic waters which are characterized by high algae growth, high turbidity, and fewer species due to lower dissolved oxygen levels. The algae blooms and scarce fish makes Eutrophic waters less desirable. This process may occur over a long period of time but human activities almost always accelerate this process. One of the major goals of the water quality program is to reduce or mitigate the human effects on the eutrophication process. This requires a monitoring program to determine the levels of nutrient input and phytoplankton levels. The individual species within each individual phytoplankton group are shown in Section IV.

The nutrient, alkalinity and chemical oxygen demand (COD) data shown in Section V indicates that excessive nutrients are not present that would cause undesirable phytoplankton blooms, that the lake water is well buffered and there is not an excess of oxygen-demanding substances in the inflows. It should be noted that alkalinity, chloride

and sulfate levels are relatively higher than the other lakes and therefore these elements will be closely monitored in the future.

The dissolved heavy metals did not exceed the drinking water standard or the freshwater fishery criteria during either the Spring or Summer except for dissolved manganese but only at the bottom of the lake. The graphs are shown in Section V for the surface and bottom waters of the Lakes and it's inflows and outflows.

Dissolved mercury levels of 0.050 ppb found on the lake surface for Summer 2000 but decreased to 0.002 ppb for the Summer of 2001. 0.2 ppb of mercury was found in the lake bottom in Spring 2000 but decreased to 0.0049 ppb in Spring 2001. Based on mercury levels found in 1999 and 2000, a fish tissue program was initiated for the first time in 2000. The results from three composited catfish that were collected on Oct 10, 2000 resulted in a total mercury level of 0.37 ppm. The 0.37 ppm result is less than the FDA criteria of 1 ppm for a fish advisory and 0.37 ppm is considered near the average level of mercury found in fish collected at the other lakes. For 2001, three large mouth bass were collected on Aug 29, 2001 and the composited results were higher at 0.58 ppm. These results are considered relatively high compared to the other lakes. It is clear that fish tissue analysis must continued for Lake Black Butte. The results are provided in Section VI.

Methyl mercury in fish tissue is a real concern to sensitive humans such as pregnant woman, small children and any groups of people who consumes a higher percentage of fish compared to the general population. At the end of Section VI are the

EPA fact sheets on mercury in fish tissue. If the results are confirmed to be high and sufficient data is available, a human risk assessment will be conducted to determine if a fish advisory is necessary at Lake Black Butte to protect sensitive humans. This potential fish advisory is not mandatory by the FDA but may be advisable based on the risk assessment study. The study will be conducted in 2003 which sufficient data becomes available.

The MTBE results for 2000 were non-detectable levels for the spring of 2000 but 5 ppb of MTBE was found on surface water near the dam in the summer of 2000. 5 ppb of MTBE was also found on surface water near the marina in the summer. The MTBE results for 2001 were all non-detectable levels and therefore MTBE is not considered a problem at Lake Black Butte. The results are provided in Section VII. At the end of Section VII is the EPA fact sheet on MTBE in drinking water. Unlike mercury, which has a known toxic effect on humans, there is little data connecting MTBE to human toxicity. However, since MTBE is considered controversial, it is recommended that MTBE data be continued to be collected.

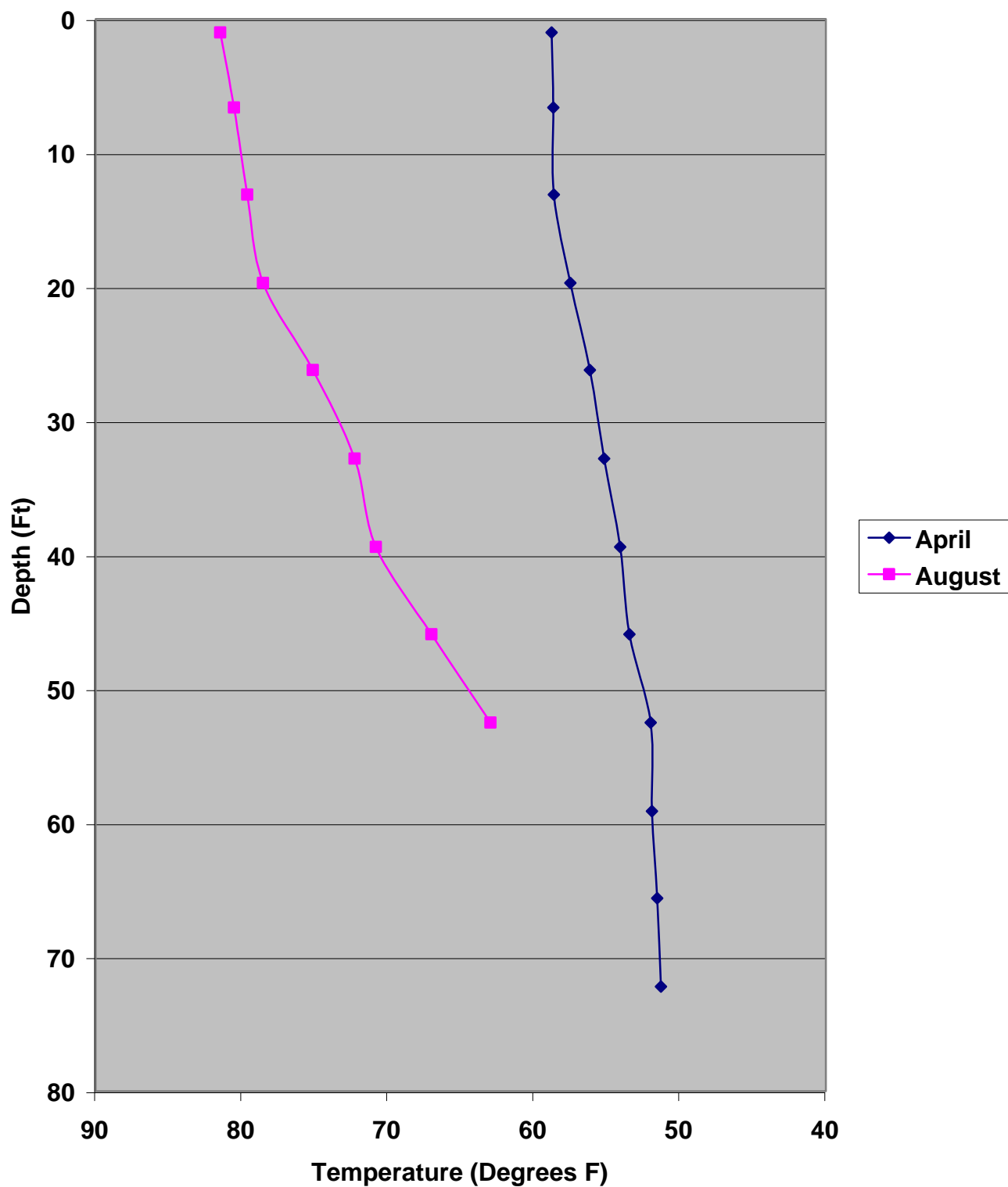
In summary, total mercury levels in fish tissue is the only parameter of concern at this time but the mercury levels are less than the FDA criteria for a fish advisory. The mercury level for the three large mouth bass is considered higher than average. The dissolved manganese exceeded the drinking water standard but this was only at the bottom of the lake. The manganese levels for the surface water were below the drinking

water standard. The other elements do not indicate any significant problem but will continue to be monitored in the future.

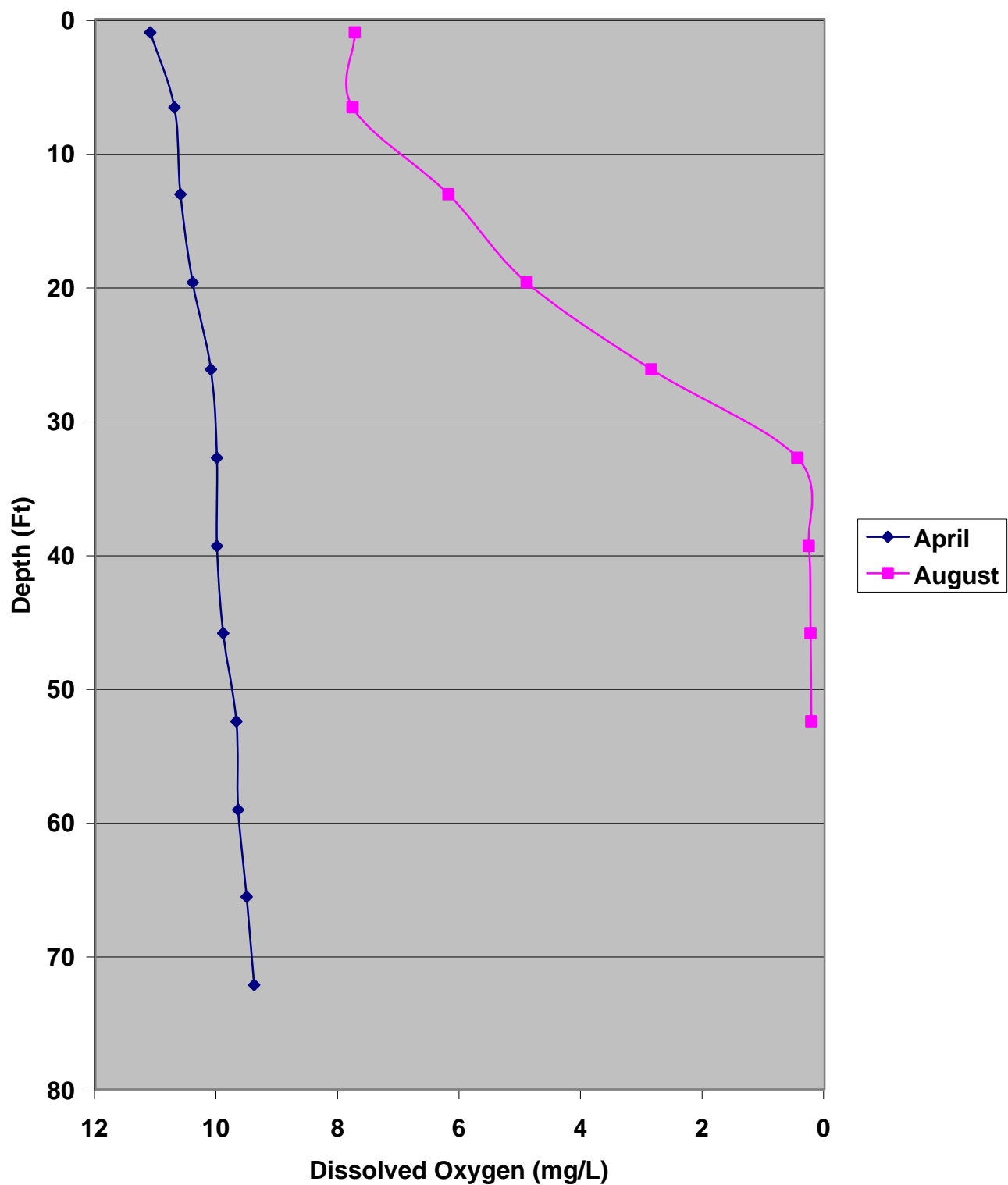


## **II      Temperature/pH/DO profile**

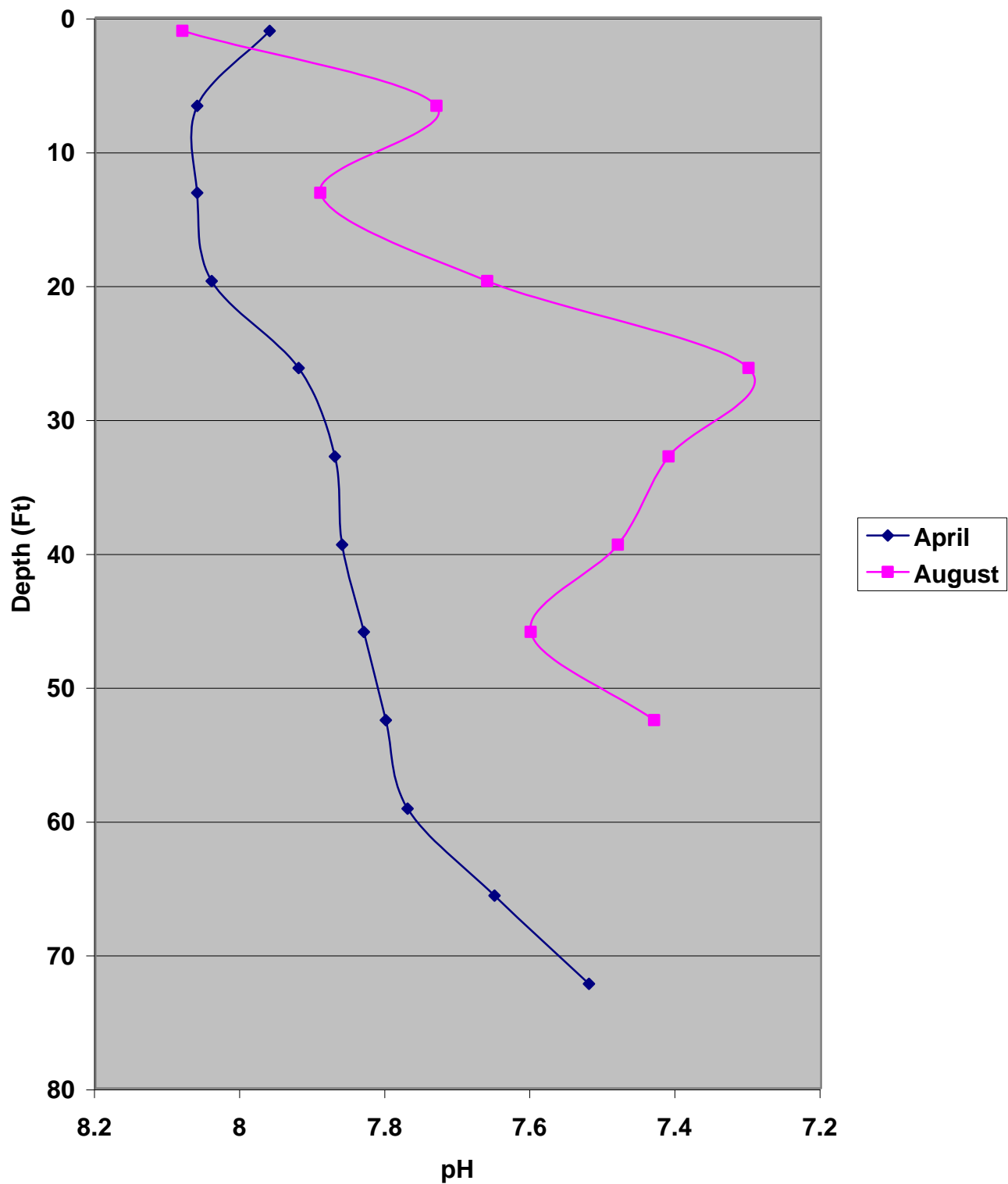
## Lake Black Butte - Temperature Profile



## Lake Black Butte - Dissolved Oxygen Profile



# Lake Black Butte - pH Profile



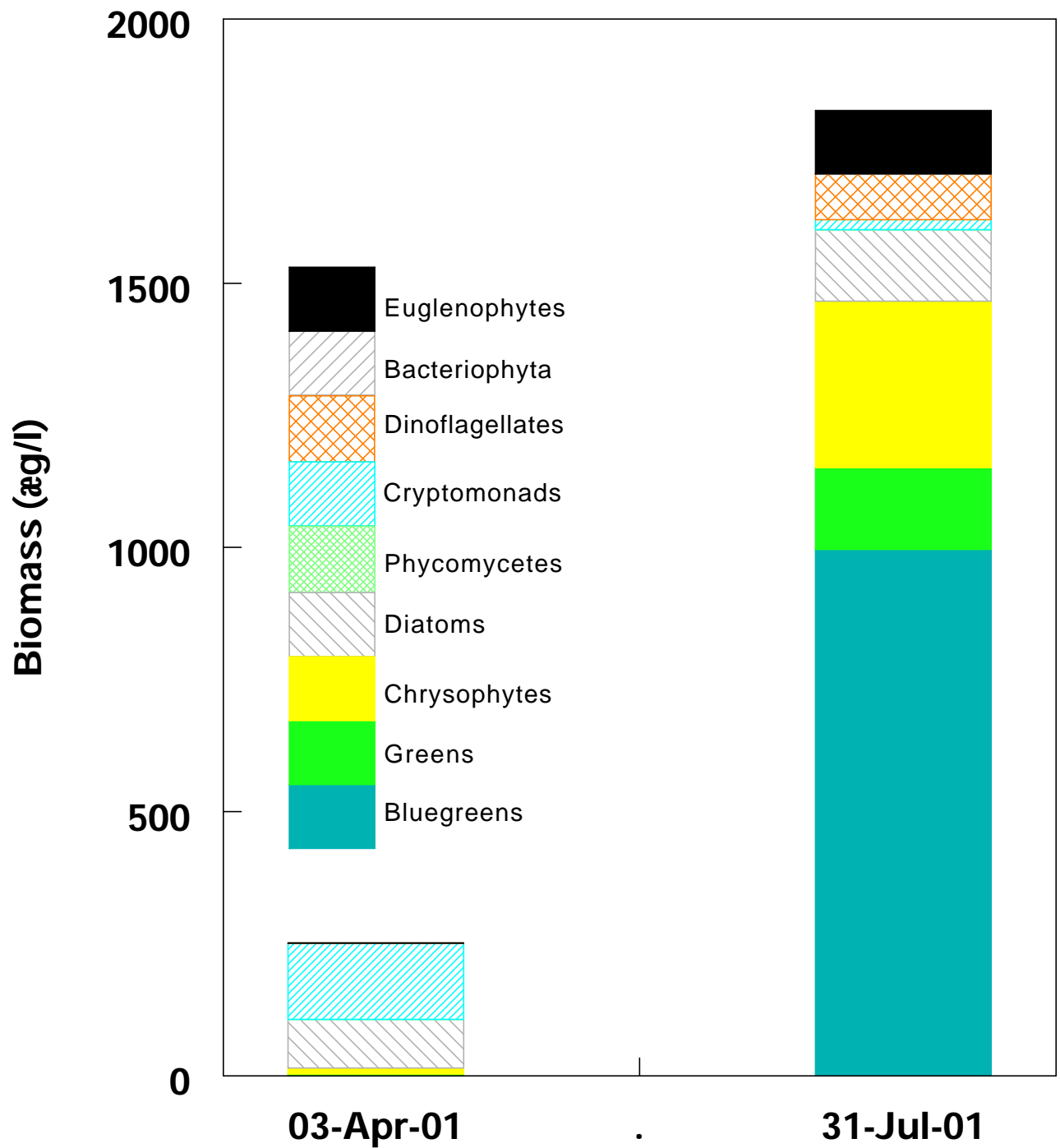
Black Butte					
Sample Location: Behind Dam				Date: 04/03/01	
Observers:Tim McLaughlin				Time: 11:00 am	
Lake Elevation: 465.28					
Weather Conditions:					
Wind Speed: 20		Precipitation: 0		Temp (F): 60	
SECCHI Depth: 3 Feet					
Depth-M	Depth-F	Temp-C	Cond	DOmg/L	pH
21.6	72.2	10.72	292	9.39	7.52
20	65.6	10.86	291	9.51	7.65
18	59.1	11.06	293	9.65	7.77
16	52.5	11.11	290	9.68	7.80
14	45.9	11.92	291	9.9	7.83
12	39.4	12.27	291	10	7.86
10	32.8	12.88	291	10	7.87
8	26.2	13.42	291	10.1	7.92
6	19.7	14.16	290	10.4	8.04
4	13.1	14.79	288	10.6	8.06
2	6.6	14.81	288	10.7	8.06
0.03	1.0	14.88	289	11.1	7.96
NORTH FORK STONY CREEK (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
60.1	8.16		-	-	-
SOUTH FORK STONY CREEK (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
56.2	8.48		-	-	-
VISUAL OBSERVATIONS: Windy, water cloudy with some debris on surface.					

Black Butte					
Sample Location: Behind Dam				Date: 07/03101	
Observers:Tim McLaughlin				Time: 10:00 am	
Lake Elevation: 452.91					
Weather Conditions:					
Wind Speed: 0		Precipitation: 0		Temp (F): 75	
SECCHI Depth: 6 Feet and 7 inches					
Depth-M	Depth-F	Temp-C	Cond	DOmg/L	pH
15	52.5	17.2	349	0.22	7.43
14	45.9	19.45	350	0.23	7.60
12	39.4	21.56	353	0.26	7.48
10	32.8	22.37	354	0.45	7.41
8	26.2	23.96	359	2.85	7.30
6	19.7	25.85	359	4.9	7.66
4	13.1	26.45	357	6.19	7.89
2	6.6	26.96	347	7.77	7.73
0.03	1.0	27.48	345	7.73	8.08
NORTH FORK STONY CREEK (Inflow) - DRY					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
-	-		-	-	-
SOUTH FORK STONY CREEK (Inflow)					
Temp (F)	pH		DOmg/L	EC	Flow rate (cfs)
82.1	7.53		-	-	-
VISUAL OBSERVATIONS:					

# **III    Phytoplankton**

# Phytoplankton Biomass 2001

## Black Butte





# Phytoplankton Normalized Sample Summary

## Army Corps of Engineers - Standard samples

Sample location: Black Butte Lake  
 Sample description:  
     Sampled on 04/03/01 by AC  
     Sample type: Composite      Cm settled: 1.10

Species	Species name	Group	Units/L	BioVol (mg/L)
GLOECY	Gloeocystis sp.	Chlorophytes	7273	3.493
<b>Chlorophytes Totals:</b>			7273	3.493
Species	Species name	Group	Units/L	BioVol (mg/L)
BICOAI	Bicosoeca ainikkiae	Chrysophytes	7261	0.174
FLAGSM	Flagellates (<5µm)	Chrysophytes	21783	0.327
MALLAK	Mallomonas akrokomas	Chrysophytes	29044	10.805
<b>Chrysophytes Totals:</b>			58088	11.306
Species	Species name	Group	Units/L	BioVol (mg/L)
CRYPT	Cryptomonas sp.	Cryptomonads	100202	130.173
RHODMN	Rhodomonas minuta	Cryptomonads	348533	13.941
<b>Cryptomonads Totals:</b>			448735	144.114
Species	Species name	Group	Units/L	BioVol (mg/L)
FRAGCA	Fragilaria capucina	Diatoms	909	1.124
MELODI	Aulacosira distans	Diatoms	14522	6.724
STEPHD	Stephanodiscus dubius	Diatoms	3636	84.355
<b>Diatoms Totals:</b>			19067	92.203
<b>Sample total:</b>				251.116

# Phytoplankton Normalized Sample Summary

## Army Corps of Engineers - Standard samples

Sample location: **Black Butte Lake**  
Sample description:  
Sampled on **07/31/01** by **AC**  
Sample type: **Composite** Cm settled: **0.50**

Species	Species name	Group	Units/L	BioVol (mg/L)
ANKIFU	Ankistrodesmus fusiformis	Chlorophytes	4000	0.352
CARTSP	Carteria sp.	Chlorophytes	8000	6.568
CLOSGR	Closterium gracile	Chlorophytes	6000	4.620
COELAS	Coelastrum sp.	Chlorophytes	2000	1.048
ELAKGE	Elaktothrix gelatinosa	Chlorophytes	6000	0.744
KIRSIR	Kirchneriella irregularis	Chlorophytes	1492000	74.600
KOLISL	Koliella spiculiformis	Chlorophytes	8000	0.638
MONOM	Monoraphidium minutum	Chlorophytes	95847	9.681
PANDNO	Pandorina morum	Chlorophytes	72000	45.821
TREUSE	Treubaria setigera	Chlorophytes	63898	10.607
<b>Chlorophytes Totals:</b>			<b>1757745</b>	<b>154.679</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
DINOCY	Dinobryon cyst	Chrysophytes	95847	169.361
FLAGSM	Flagellates (<5µm)	Chrysophytes	5399361	80.990
SPINSP	Spiniferomonas sp.	Chrysophytes	127796	64.869
<b>Chrysophytes Totals:</b>			<b>5623004</b>	<b>315.220</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
CRYPT	Cryptomonas sp.	Cryptomonads	10000	13.929
RHODMN	Rhodomonas minuta	Cryptomonads	127796	5.112
<b>Cryptomonads Totals:</b>			<b>137796</b>	<b>19.041</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
ANABIN	Anabaena inaequalis	Cyanophytes	254000	16.510
APHANI	Apanizomenon flos-aque	Cyanophytes	4565041	963.224
MERIWA	Merismopedia warmingiana	Cyanophytes	16613419	16.613
<b>Cyanophytes Totals:</b>			<b>21432460</b>	<b>996.347</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
MELODI	Aulacosira distans	Diatoms	10000	4.630
MELOGA	Aulacosira granulata v. angustissima	Diatoms	12000	12.216
RHIZOL	Rhizosolenia longiseta	Diatoms	8000	4.696
SYNDRA	Synedra radians	Diatoms	238000	113.526
<b>Diatoms Totals:</b>			<b>268000</b>	<b>135.068</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
ASTAS	Astasia dangeardii	Euglenophyta	4000	10.195
EUGGRA	Euglena gracilis	Euglenophyta	4000	13.872
TRACSP	Trachelomonas sp.	Euglenophyta	14000	95.838
<b>Euglenophyta Totals:</b>			<b>22000</b>	<b>119.905</b>

Species	Species name	Group	Units/L	BioVol (mg/L)
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# Phytoplankton Normalized Sample Summary

## Army Corps of Engineers - Standard samples

CERATI	Ceratium hirundinella	Pyrrhophytes	2000	74.000
PERIQU	Peridinium quadridens	Pyrrhophytes	2000	12.653
<b>Pyrrhophytes Totals:</b>			4000	86.653
<b>Sample total:</b>				1826.913

# **IV      Nutrient and Miscellaneous Parameters**

## 2001 Lake Monitoring Results for Organics

Pesticides and Herbicides were discontinued in 2001 since the results from 1995 to 2000 were consistently “non-detect” and the program’s current effort is to focus on MTBE and mercury levels in fish tissue.

The following tables on the next page are the 2001 Lake Monitoring Results for general Organics related to nutrients (which may cause algae blooms) and miscellaneous water quality parameters which may have an adverse impact on aquatic life such as Chemical Oxygen Demand and ammonia (which may cause a fish kill).

The results in the following tables indicate no potential for significant adverse impact.

### Notes:

Alkalinity is reported as “Total Alkalinity as CaCO<sub>3</sub>”

Ammonia is reported as “Ammonia as N”

Nitrate is reported as “Nitrate + Nitrate as N”

Total P is reported as “Phosphate as P. total”

Ortho P is reported as “Phosphate as P. Ortho”

Kjedahl N is reported as “Total Kjeldahl Nitrogen”

COD is “Chemical Oxygen Demand”

Tot Solids is reported as “Solids, Tot”

### Lake codes are as follows:

BB	Black Butte
EA	Eastmand
EN	Englebright
HE	Hensley
IS	Isabella
KA	Kaweah
MC	Martis Creek
ME	Mendocino
NH	New Hogan
PF	Pine Flat
SO	Sonoma
SU	Success

**Inorganic Results (mg/L) For surface lake waters (spring)**

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	120	50	40	30	60	40	60	80	70	10	70	120
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Chloride	12	20	5	18	5	<1	3	2	7	1	3	6
Nitrate	<0.1		<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1			<0.1	<0.1	<0.1	<0.1		<0.1	<0.1		<0.1
Sulfate	15	2	3.6	4	7.8	1.8	1	7	8.5	2	6	4.8
Kjeldahl N	0.3	<0.1	<0.1	0.3	0.3	0.2	.4	0.3	0.3	0.2	0.3	0.3
COD		<50		<50	<50	<50	<50			<50		<50
Tot Solids	180	100	70	100	100	70	100	40	110	30	99	170

**Inorganic Results (mg/L) For inlet waters to the lakes (spring) (I-1 only)**

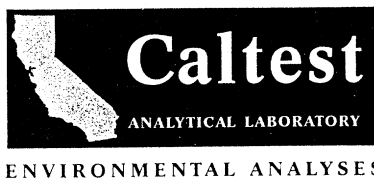
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	110	50	40	30	40	20	40	80	90	10	100	50
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Chloride	10	15	5	19	2	<1	<1	2	9	1	4	1
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total P		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	13	0.9	2.1	2	4.8	0.8	<1	8	12	2	10	3.3
Kjeldahl N	0.1	0.2	<0.1	0.2	0.8	0.3	0.4	0.2	0.2	0.1	0.2	0.4
COD		<50	<50	<50	<50	<50		<50	<50	<50	<50	<50
Tot Solids	160	120	60	100	80	50	70	110	130	90	140	110

**Inorganic Results (mg/L) For surface lake waters (summer)**

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	130	60	40	50	50	40	80	90	80	20	<10	120
Ammonia	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1		0.1
Chloride	20	14	<1	11	2	5	6	6	4	<1	7	8
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	1.4		<0.1	0.1		0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	13	1.7	2.6	1.8	4	1.5	<0.5		9.4	1	6.4	2.9
Kjeldahl N	0.2	0.7	<0.1	0.5	0.3	0.2	1.7		0.2	0.2		0.5
COD	<50	<50	<50	<50	<50		<50	<50	<50	<50	<50	
Tot Solids	190	120	59	100	90	70	120	120	110	30	99	170

**Inorganic Results (mg/L) For inlet waters to the lakes (summer) (I-1 only)**

	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	150	100	40		60	50		90	100	20		
Ammonia												
Chloride	15	360	<1		4	5	3	7	6	1		
Nitrate												
Total P												
Ortho P												
Sulfate	9.8	3.5	2.3		5.9	1.9		3.2		2.2		
Kjeldahl N												
COD												
Tot Solids	190	1000	60		100	90	110	120	150	40		



LAB ORDER No.:

B080129  
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INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080129-1								
SAMPLE ID: BB-SU-S								
SAMPLED: 31 JUL 01 10:00								
Mercury, Trace Level	0.0021	0.0005	ug/L	1	1631	08.10.01	A010764MER	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	08.06.01	B010221COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	
ALKALINITY				1	310.1	08.14.01	I010038ALK	
Bicarbonate as CaCO3	130.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	130.	10.	mg/L					
Ammonia as N	0.1	0.1	mg/L	1	350.2	08.09.01	I010087AMM	
Chloride	20.	10.	mg/L	10	300.0	08.28.01	I010121IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	08.09.01	I010032NNO	
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	08.10.01	I010088PHO	
Solids, Dissolved	180.	10.	mg/L	1	160.1	08.07.01	I010053TDS	
Solids, Total	190.	10.	mg/L	1	160.3	08.07.01	I010015TS	
Sulfate	13.	0.5	mg/L	1	300.0	08.28.01	I010121IC	
Total Kjeldahl Nitrogen	0.2	0.1	mg/L	1	351.3	08.06.01	I010060TKN	

LAB NUMBER: B080129-3  
SAMPLE ID: BB-SU-I-1  
SAMPLED: 31 JUL 01 11:30

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	08.13.01	A010760ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	08.13.01	A010760ICP	2
Calcium, dissolved	34.	0.5	mg/L	1	200.7	08.14.01	A010760ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2
Iron, dissolved	ND	0.05	mg/L	1	200.7	08.13.01	A010760ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	08.13.01	A010760ICP	2
Magnesium, dissolved	14.	0.5	mg/L	1	200.7	08.13.01	A010760ICP	2
Manganese, dissolved	JO.002	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2,3
Potassium, dissolved	2.	1.	mg/L	1	200.7	08.13.01	A010760ICP	2
Selenium, dissolved	ND	0.001	mg/L	1	270.3	08.14.01	A010768FIA	4
Sodium, dissolved	17.	1.	mg/L	1	200.7	08.13.01	A010760ICP	2
Zinc, dissolved	ND	0.02	mg/L	1	200.7	08.13.01	A010760ICP	2
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	

- 1) Sample Preparation on 08-09-01 using 1631
- 2) Sample Preparation on 08-09-01 using 200.2 (Filtrate)
- 3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).
- 4) Sample Preparation on 08-13-01 using 3010



INORGANIC ANALYTICAL RESULTS

LAB ORDER No.:

B080129  
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ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
ALKALINITY				1	310.1	08.06.01	I010035ALK	
Bicarbonate as CaCO <sub>3</sub>	150.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	150.	10.	mg/L					
Chloride	15.	1.	mg/L	1	300.0	08.28.01	I010121IC	
Solids, Dissolved	190.	10.	mg/L	1	160.1	08.07.01	I010053TDS	
Solids, Total	190.	10.	mg/L	1	160.3	08.07.01	I010015TS	
Sulfate	9.8	0.5	mg/L	1	300.0	08.28.01	I010121IC	

LAB NUMBER: B080129-4  
SAMPLE ID: BB-SU-B  
SAMPLED: 31 JUL 01 10:30

Arsenic, dissolved	0.007	0.004	mg/L	1	200.7	08.13.01	A010760ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	08.13.01	A010760ICP	1
Calcium, dissolved	34.	0.5	mg/L	1	200.7	08.14.01	A010760ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Iron, dissolved	0.07	0.05	mg/L	1	200.7	08.13.01	A010760ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	08.13.01	A010760ICP	1
Magnesium, dissolved	15.	0.5	mg/L	1	200.7	08.13.01	A010760ICP	1
Manganese, dissolved	0.32	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Mercury, Trace Level	0.0090	0.0005	ug/L	1	1631	08.10.01	A010764MER	2
Potassium, dissolved	2.	1.	mg/L	1	200.7	08.13.01	A010760ICP	1
Selenium, dissolved	0.002	0.001	mg/L	1	270.3	08.14.01	A010768FIA	3
Sodium, dissolved	16.	1.	mg/L	1	200.7	08.13.01	A010760ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	08.13.01	A010760ICP	1

LAB NUMBER: B080129-5  
SAMPLE ID: NH-SU-S  
SAMPLED: 01 AUG 01 10:00

Mercury, Trace Level	0.0015	0.0005	ug/L	1	1631	08.10.01	A010764MER	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	08.06.01	B010221COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	
ALKALINITY				1	310.1	08.14.01	I010038ALK	
Bicarbonate as CaCO <sub>3</sub>	80.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	80.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	08.09.01	I010087AMM	
Chloride	4.	1.	mg/L	1	300.0	08.29.01	I010121IC	

- 1) Sample Preparation on 08-09-01 using 200.2 (Filtrate)
- 2) Sample Preparation on 08-09-01 using 1631
- 3) Sample Preparation on 08-13-01 using 3010







## ENVIRONMENTAL ANALYSES

## INORGANIC ANALYTICAL RESULTS

(Amended)

LAB ORDER No.:

B040152

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ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040152-4 (continued)								
Potassium, dissolved	1.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Selenium, dissolved	JO.003	0.01	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Sodium, dissolved	5.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	1

LAB NUMBER: B040152-5

SAMPLE ID: BB-SP-S

SAMPLED: 03 APR 01

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	1
Calcium, dissolved	26.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.16.01	A010345ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	1
Magnesium, dissolved	12.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Manganese, dissolved	JO.002	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Mercury, Trace Level	5.0	0.5	ng/L	1	1631	04.17.01	A010354MER	3
Potassium, dissolved	1.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Selenium, dissolved	JO.002	0.01	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Sodium, dissolved	15.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	04.10.01	B010102TSS	
ALKALINITY				1	310.1	04.05.01	I010018ALK	
Bicarbonate as CaCO <sub>3</sub>	120.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	120.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.10.01	I010043AMM	
Chloride	12.	5.	mg/L	5	300.0	04.26.01	I010057IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	04.27.01	I010019NNO	
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.10.01	I010029PHO	
Solids, Dissolved	180.	10.	mg/L	1	160.1	04.10.01	I010024TDS	
Solids, total	180.	10.	mg/L	1	160.3	04.16.01	I010005TS	
Sulfate	15.	0.5	mg/L	1	300.0	04.24.01	I010055IC	
Total Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	04.10.01	I010031TKN	

1) Sample Preparation on 04-13-01 using 200.2 (Filtrate)

2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

3) Sample Preparation on 04-16-01 using 1631



## ENVIRONMENTAL ANALYSES

## INORGANIC ANALYTICAL RESULTS

(Amended)

LAB ORDER No.:

B040152  
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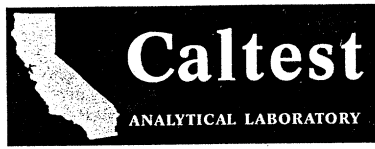
ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040152-6 SAMPLE ID: BB-SP-B SAMPLED: 03 APR 01								
Mercury, Trace Level	23.	0.5	ng/L	1	1631	04.17.01	A010354MER	1
LAB NUMBER: B040152-7 SAMPLE ID: BB-SP-I-1 SAMPLED: 03 APR 01								
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.16.01	A010345ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	2
Magnesium, dissolved	10.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	2
Manganese, dissolved	JO.002	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2.3
Potassium, dissolved	JO.9	1.	mg/L	1	200.7	04.16.01	A010345ICP	2.3
Selenium, dissolved	JO.002	0.01	mg/L	1	200.7	04.16.01	A010345ICP	2.3
Sodium, dissolved	13.	1.	mg/L	1	200.7	04.16.01	A010345ICP	2
Calcium, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.14.01	B010108COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.10.01	B010102TSS	
ALKALINITY				1	310.1	04.05.01	I010018ALK	
Bicarbonate as CaCO <sub>3</sub>	110.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	110.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.10.01	I010043AMM	
Chloride	10.	5.	mg/L	5	300.0	04.26.01	I010057IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	04.27.01	I010019NNO	
Solids, Dissolved	160.	10.	mg/L	1	160.1	04.10.01	I010024TDS	
Solids, total	160.	10.	mg/L	1	160.3	04.16.01	I010005TS	
Sulfate	13.	0.5	mg/L	1	300.0	04.24.01	I010055IC	
Total Kjeldahl Nitrogen	0.1	0.1	mg/L	1	351.3	04.10.01	I010031TKN	

LAB NUMBER: B040152-8  
SAMPLE ID: BB-SP-I-2  
SAMPLED: 03 APR 01

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	2
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- 1) Sample Preparation on 04-16-01 using 1631
- 2) Sample Preparation on 04-13-01 using 200.2 (Filtrate)
- 3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).





ENVIRONMENTAL ANALYSES

LAB ORDER No.:

B040076

INORGANIC ANALYTICAL RESULTS

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ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040076-1 SAMPLE ID: BB-SP-S SAMPLED: 03 APR 01 11:00								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.04.01	I010027PHO	1
LAB NUMBER: B040076-3 SAMPLE ID: BB-SP-I-1 SAMPLED: 03 APR 01 12:30								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.04.01	I010027PHO	1
LAB NUMBER: B040076-4 SAMPLE ID: BB-SP-I-Z SAMPLED: 03 APR 01 13:30								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	04.04.01	I010027PHO	1

1) Sample filtered prior to analysis.





ENVIRONMENTAL ANALYSES

INORGANIC ANALYTICAL RESULTS

LAB ORDER No.:

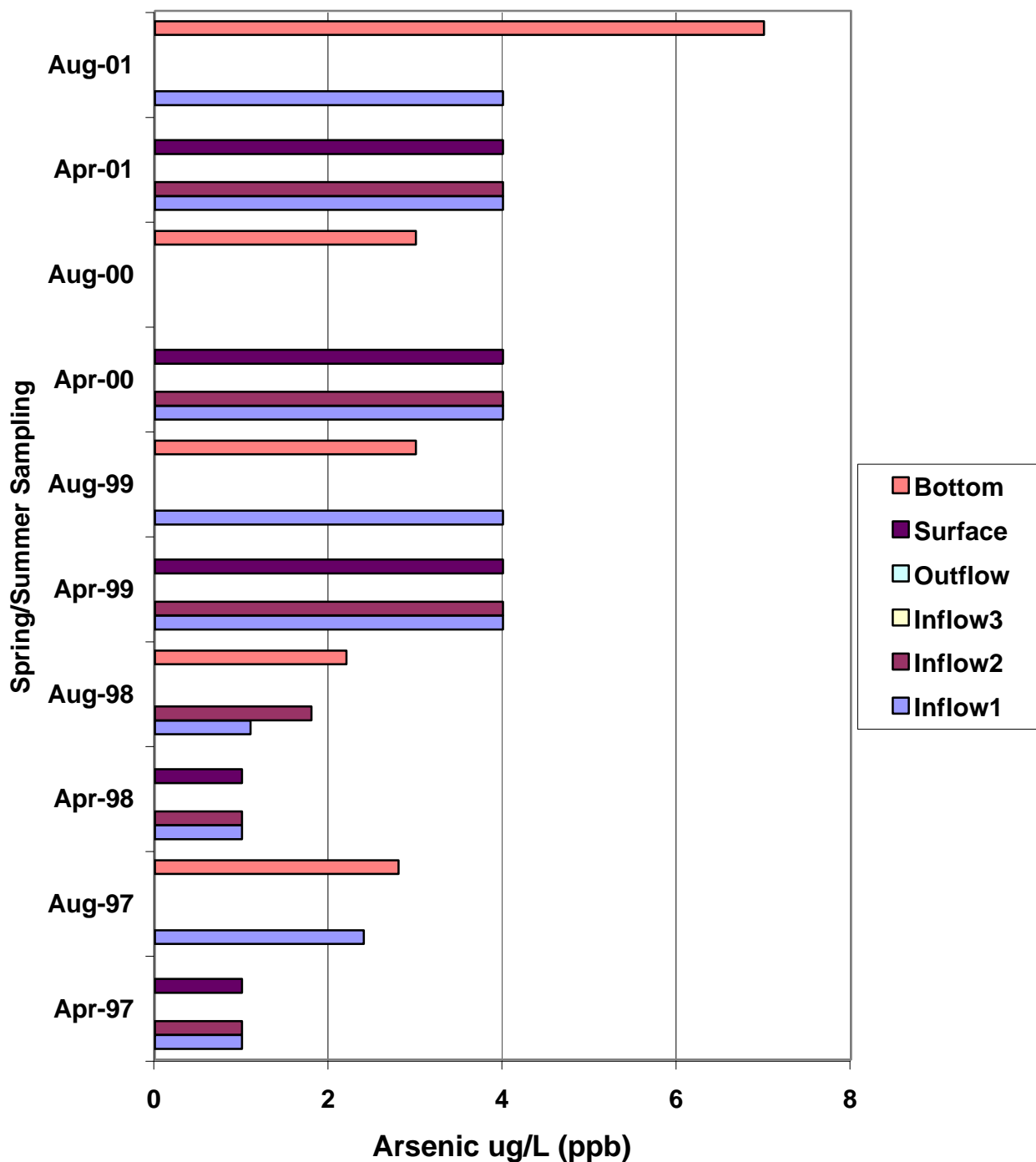
B080028  
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<u>ANALYTE</u>	<u>RESULT</u>	<u>R.L.</u>	<u>UNITS</u>	<u>D.F.</u>	<u>METHOD</u>	<u>ANALYZED</u>	<u>QC BATCH</u>	<u>NOTES</u>
LAB NUMBER: B080028-1								
SAMPLE ID: BB-SU-S								
SAMPLED: 31 JUL 01 11:00								
Phosphate as P, Ortho	ND	0.1	mg/L	1	365.2	08.01.01	I010083PHO	1

1) Sample filtered prior to analysis.

## **V Metals**

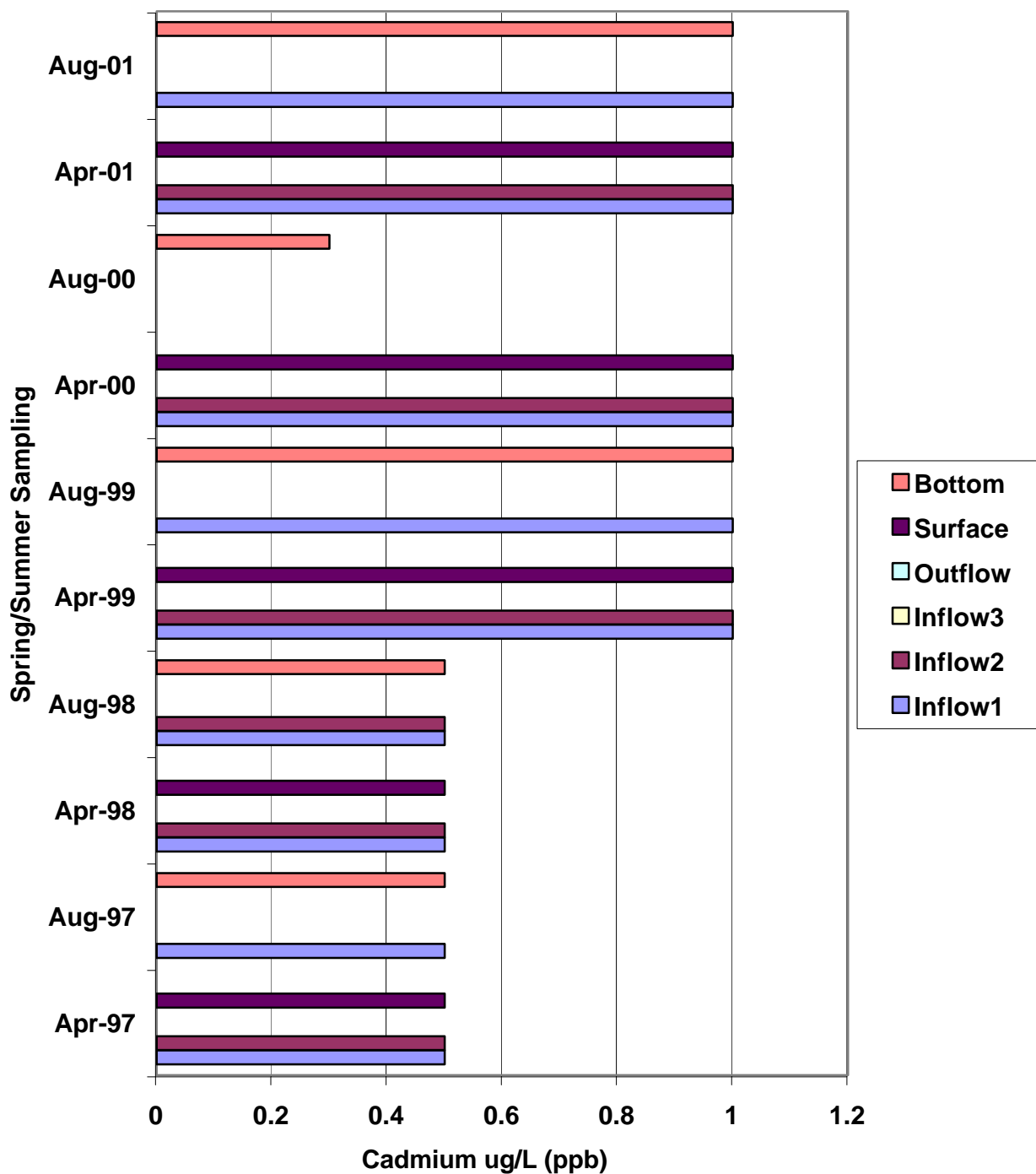
## Dissolved Arsenic - Lake Black Butte



Drinking Water Standard = 50 ug/L    Fish Criteria = 150 ug/L

Non-Detect Levels = 4 ug/L

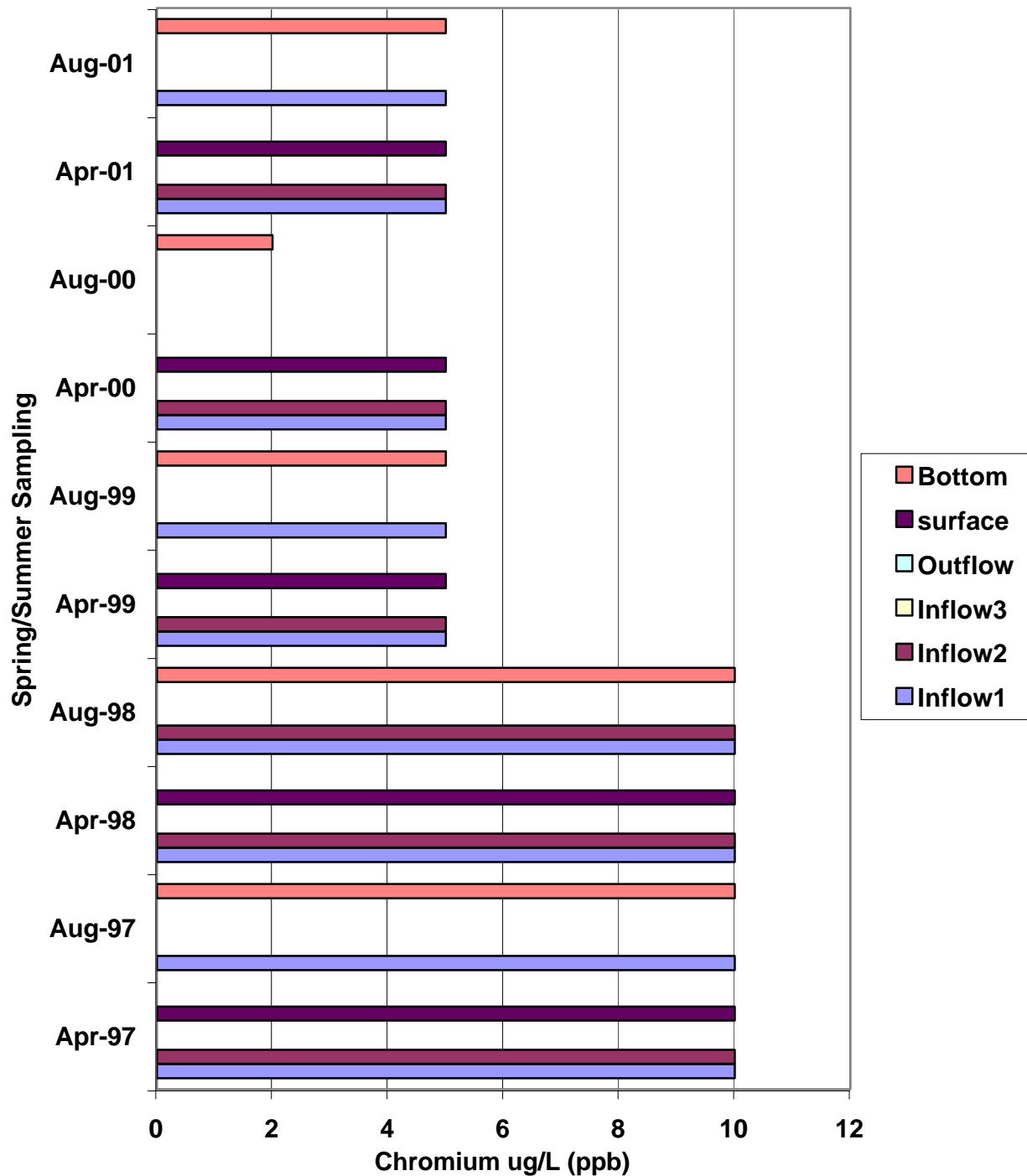
# Dissolved Cadmium - Lake Black Butte



Drinking Water Standard = 5 ug/L    Fish Criteria = 2.2 ug/L

Non-Detect Levels Prior to 1999 = 0.5 ug/L    1999 and Beyond = 1 ug/L

# Dissolved Chromium - Lake Black Butte

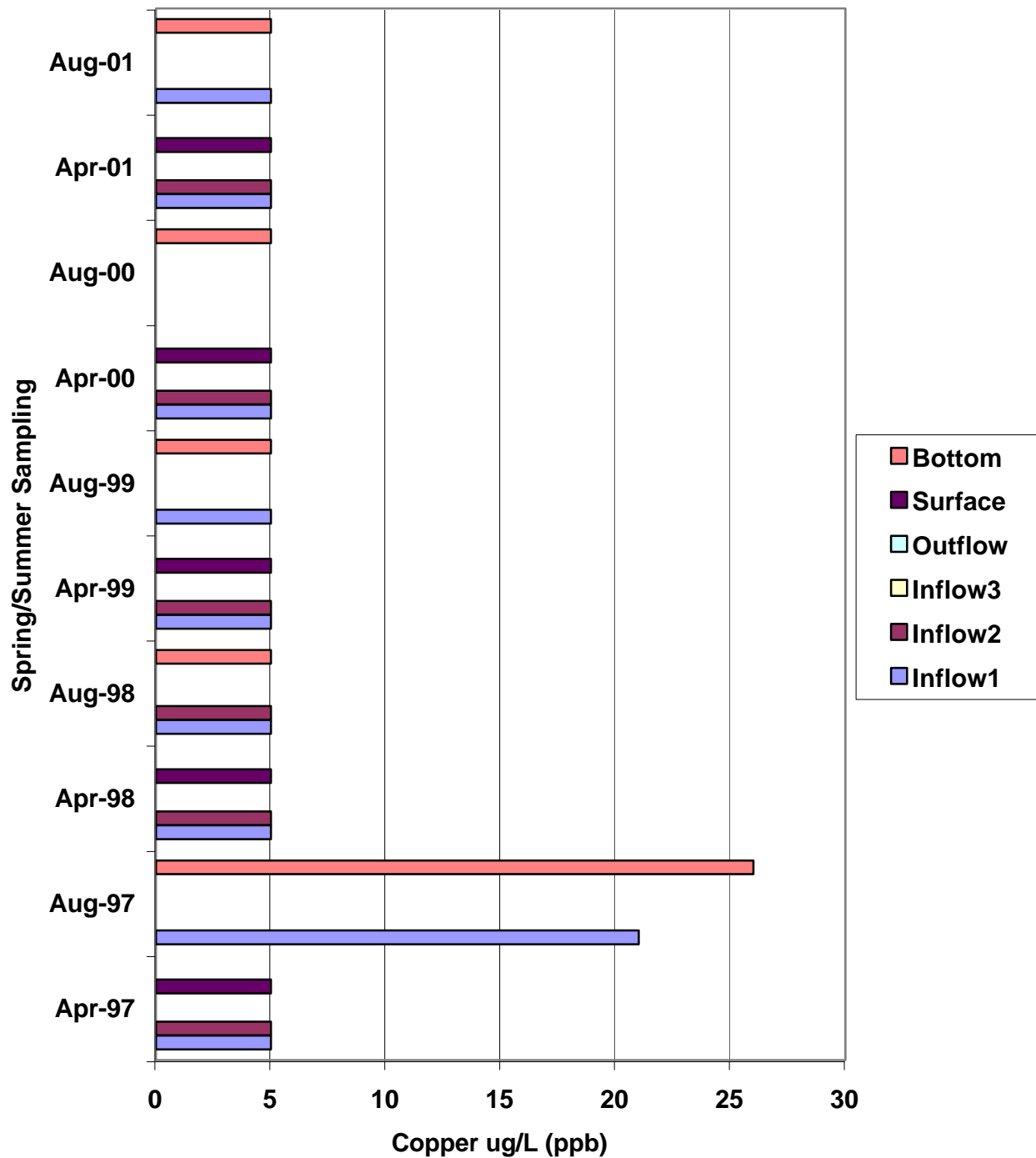


Drinking Water Standard = 50 ug/L Fish Criteria = 11 ug/L

Non-Detect Levels Prior to 1999 = 10 ug/L 1999 and Beyond = 5 ug/L



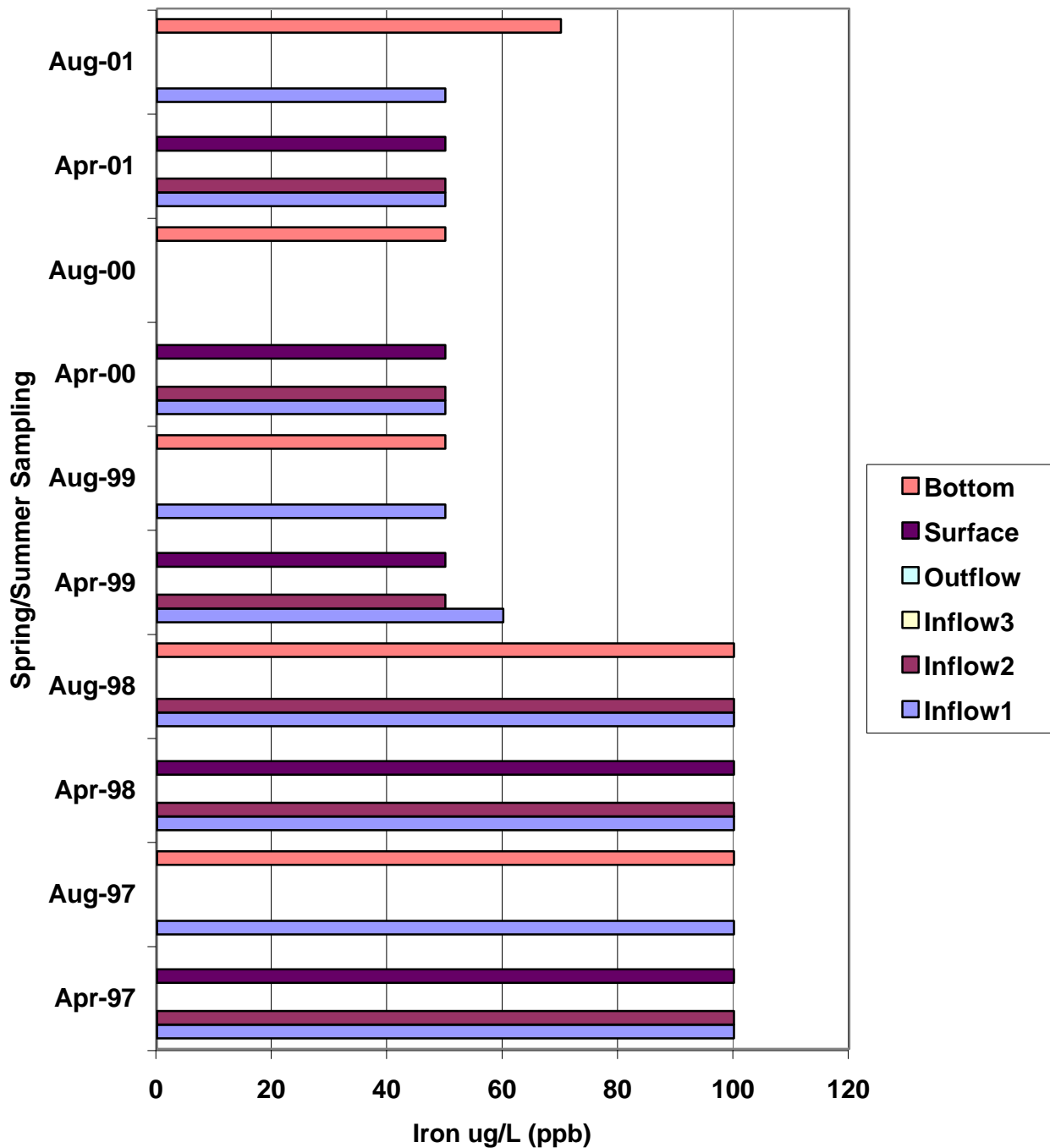
### Dissolved Copper - Lake Black Butte



Drinking Water Standard = 1300 ug/L    Fish Criteria = 9 ug/L

Non-Detect Levels = 5 ug/L

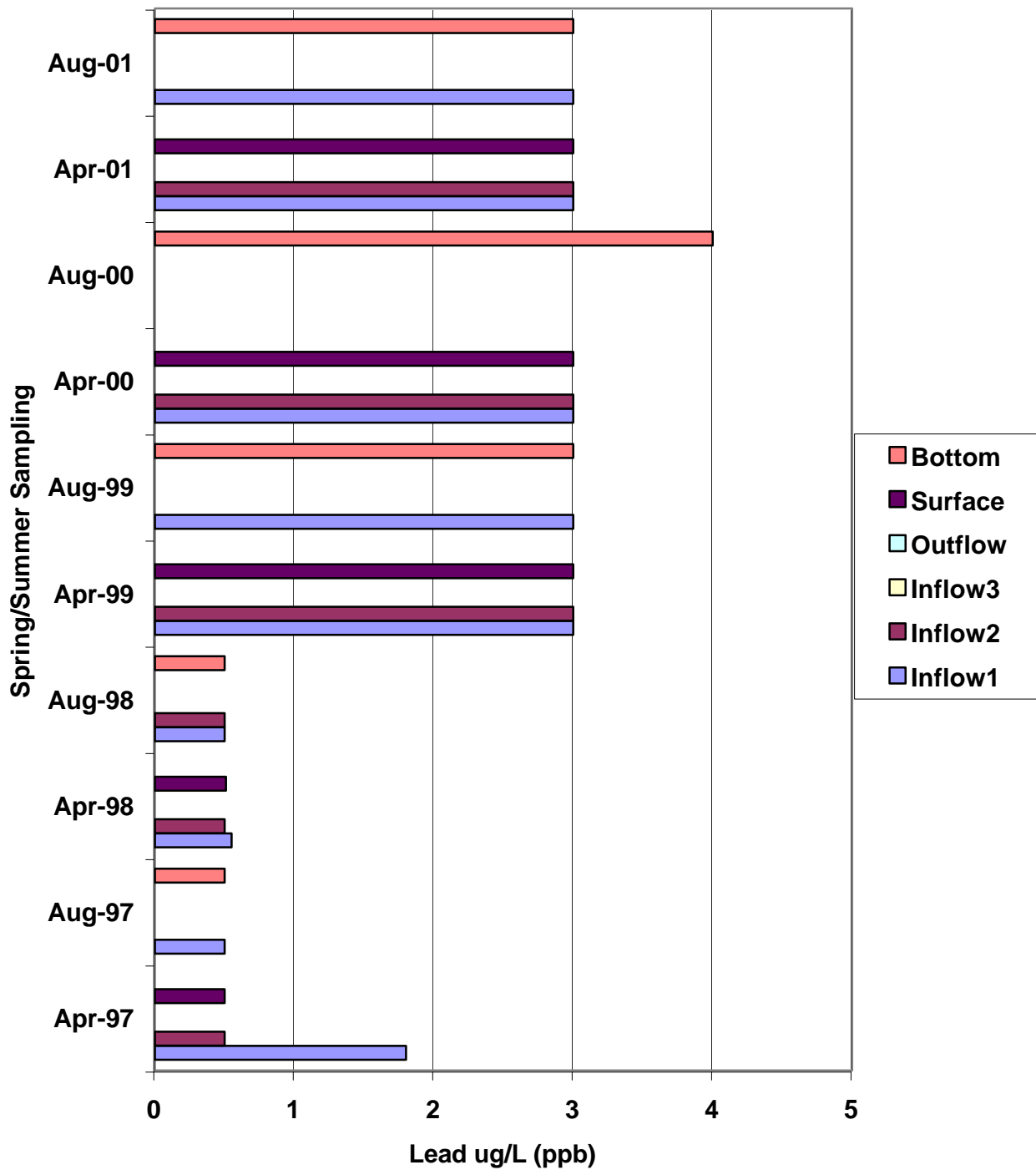
### Dissolved Iron - Lake Black Butte



Drinking Water Standard = 300 ug/L    Fish Criteria = 1000 ug/L

Non-Detect Levels Prior to 1999 = 100 ug/L    1999 and Beyond = 50 ug/L

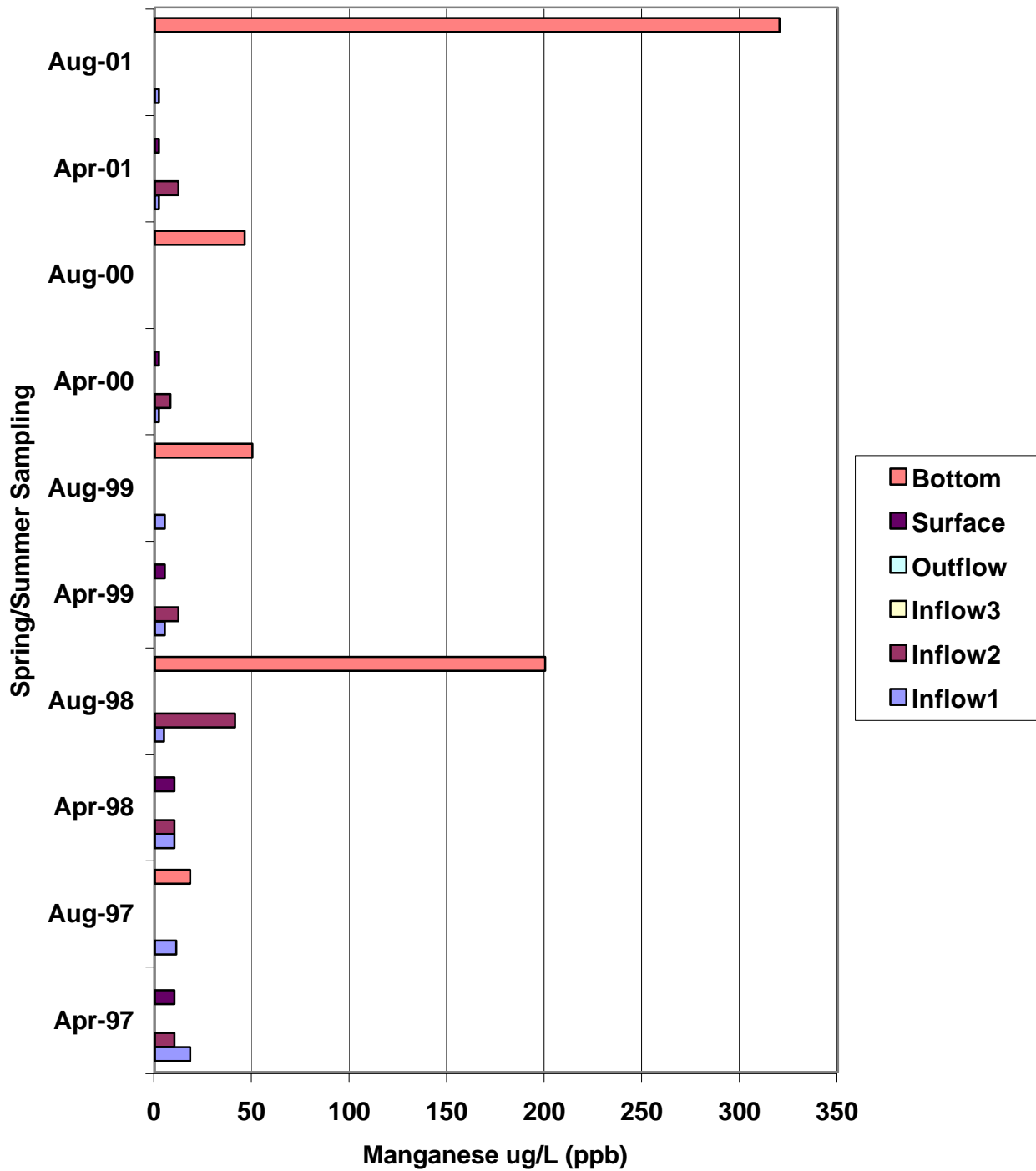
### Dissolved Lead - Lake Black Butte



Drinking Water Standard = 15 ug/L Fish Criteria = 2.5 ug/L

Non-Detect Levels = 3 ug/L

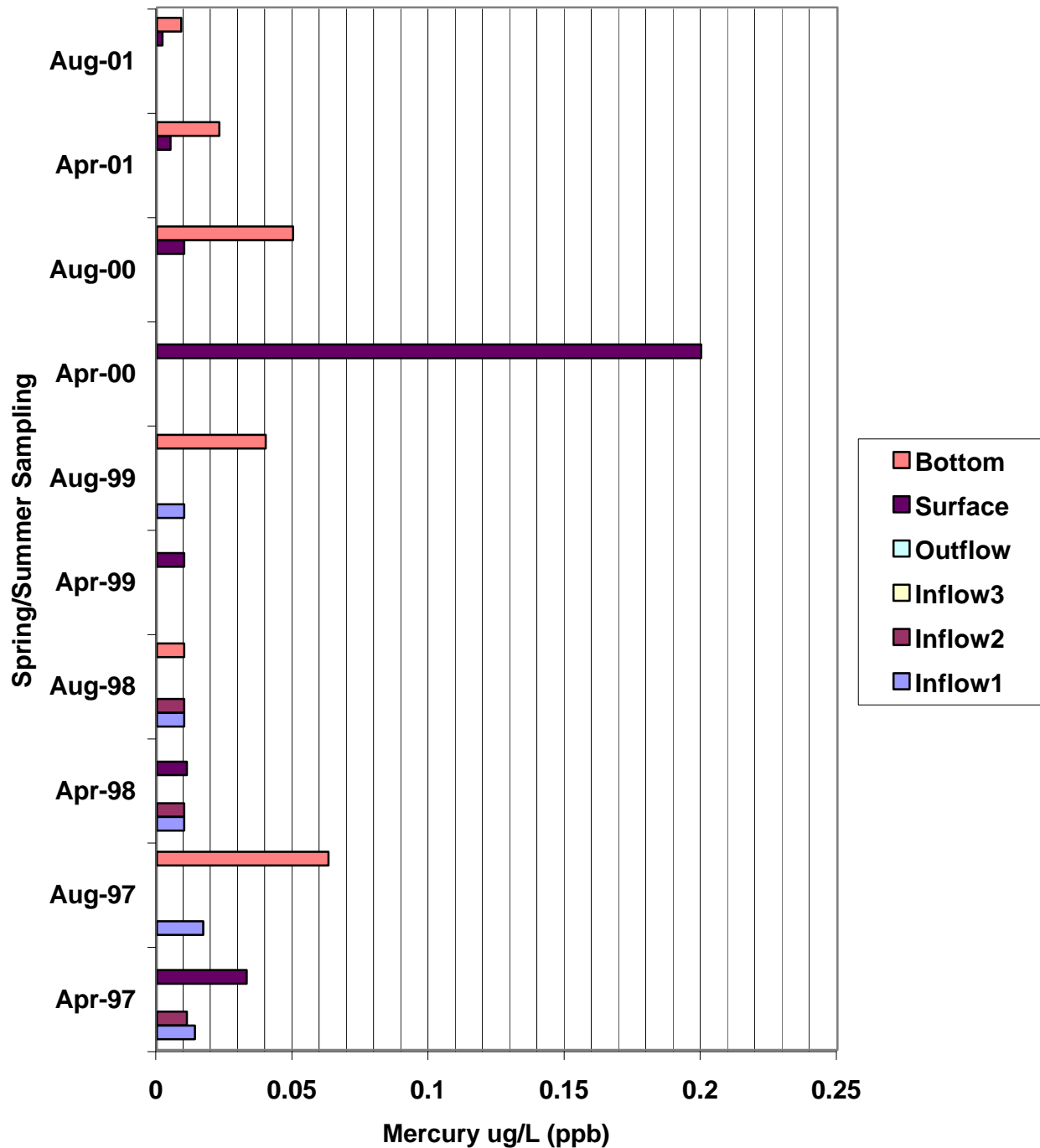
### Dissolved Manganese - Lake Black Butte



Drinking Water Standard = 50 ug/L    Fish Criteria = none

Non-Detect Levels = 5 ug/L

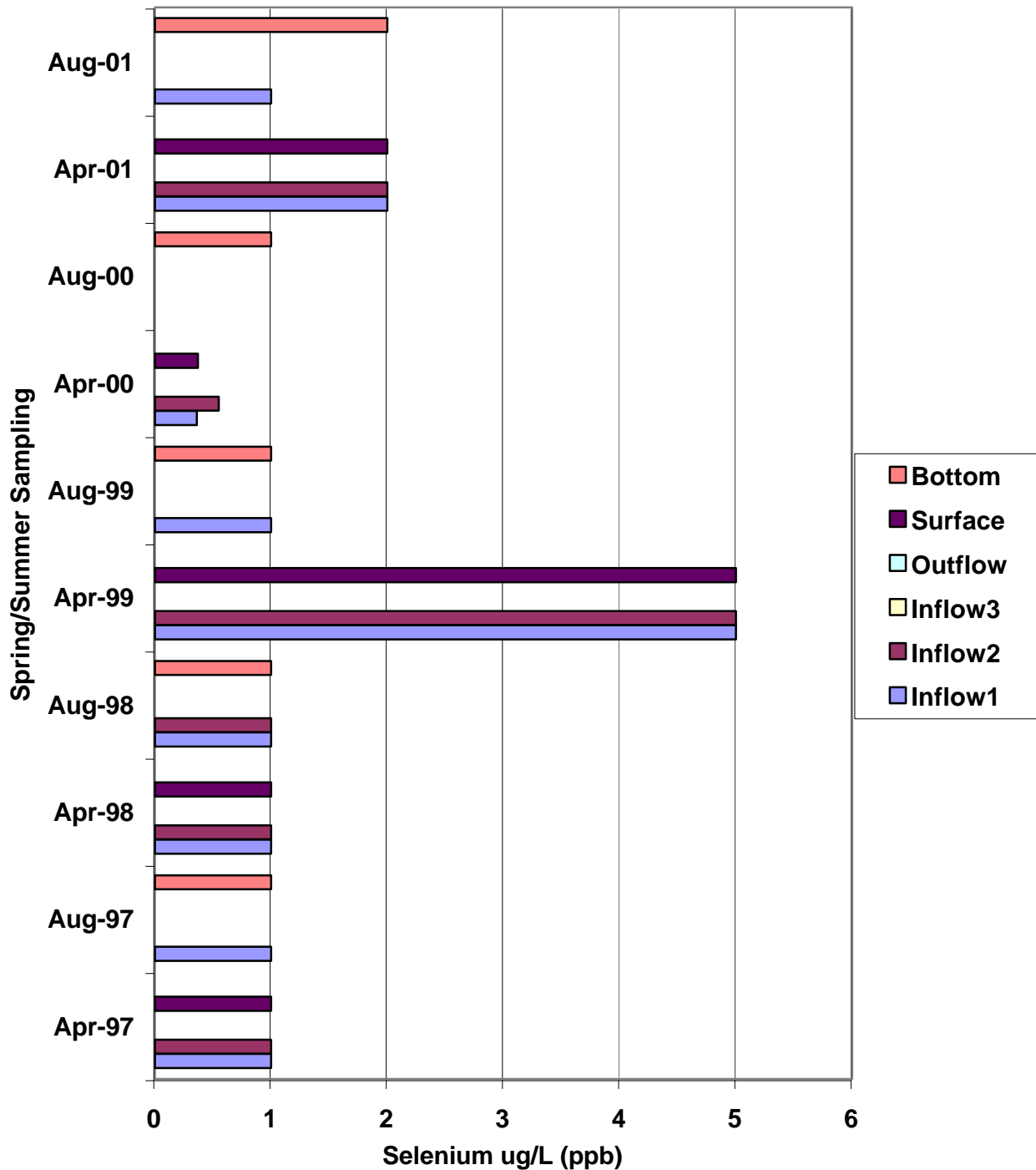
### Dissolved Mercury - Lake Black Butte



Drinking Water Standard = 2.0 ug/L      Fish Criteria = 0.012 ug/L

Non Detect Levels in 2000 = 0.2 ug/L

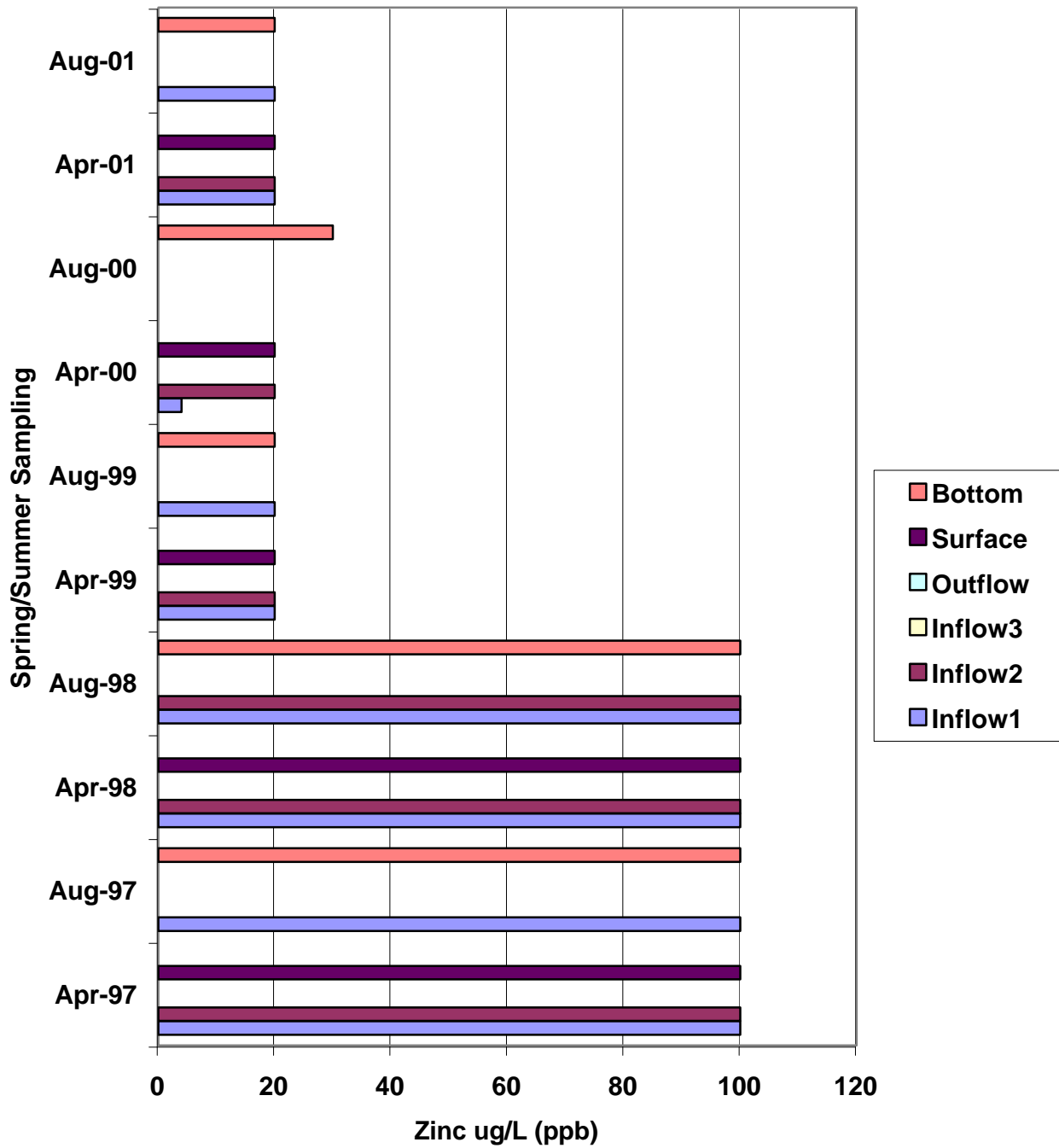
### Dissolved Selenium - Lake Black Butte



Drinking Water Standard = 50 ug/L    Fish Criteria = 5 ug/L

Non Detect Levels in 2000 = 10 ug/L

### Dissolved Zinc - Lake Black Butte



Drinking Water Standard = 5000 ug/L    Fish Criteria = 120 ug/L

Non-Detect Levels Prior to 1999 = 100 ug/L    1999 and Beyond = 20 ug/L



## ENVIRONMENTAL ANALYSES

LAB ORDER No.:

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## INORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040152-6 SAMPLE ID: BB-SP-S SAMPLED: 03 APR 01								
Mercury, Trace Level	23.	0.5	ng/L	1	1631	04.17.01	A010354MER	1
LAB NUMBER: B040152-7 SAMPLE ID: BB-SP-I-1 SAMPLED: 03 APR 01								
Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.16.01	A010345ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	2
Magnesium, dissolved	10.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	2
Manganese, dissolved	J0.002	0.005	mg/L	1	200.7	04.16.01	A010345ICP	2,3
Potassium, dissolved	J0.9	1.	mg/L	1	200.7	04.16.01	A010345ICP	2,3
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.16.01	A010345ICP	2,3
Sodium, dissolved	13.	1.	mg/L	1	200.7	04.16.01	A010345ICP	2
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.14.01	B010108COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	04.10.01	B010102TSS	
ALKALINITY				1	310.1	04.05.01	I010018ALK	
Bicarbonate as CaCO <sub>3</sub>	110.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	110.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.10.01	I010043AMM	
Chloride	10.	5.	mg/L	5	300.0	04.26.01	I010057IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	04.27.01	I010019NNO	
Solids, Dissolved	160.	10.	mg/L	1	160.1	04.10.01	I010024TDS	
Solids, total	160.	10.	mg/L	1	160.3	04.16.01	I010005TS	
Sulfate	13.	0.5	mg/L	1	300.0	04.24.01	I010055IC	
Total Kjeldahl Nitrogen	0.1	0.1	mg/L	1	351.3	04.10.01	I010031TKN	

LAB NUMBER: B040152-8  
SAMPLE ID: BB-SP-I-2  
SAMPLED: 03 APR 01

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	2
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- 1) Sample Preparation on 04-16-01 using 1631
- 2) Sample Preparation on 04-13-01 using 200.2 (Filtrate)
- 3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).







## ENVIRONMENTAL ANALYSES

LAB ORDER No.:

B040152

## INORGANIC ANALYTICAL RESULTS

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ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040152-8 (continued)								
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.16.01	A010345ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	1
Magnesium, dissolved	15.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Manganese, dissolved	0.012	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Potassium, dissolved	2.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Selenium, dissolved	J0.002	0.01	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Sodium, dissolved	16.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	04.14.01	B010108COD	
Solids, Suspended	14.	3.	mg/L	1	160.2	04.10.01	B010102TSS	
ALKALINITY				1	310.1	04.05.01	I010018ALK	
Bicarbonate as CaCO3	130.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	130.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.10.01	I010043AMM	
Chloride	14.	5.	mg/L	5	300.0	04.26.01	I010057IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	04.27.01	I010019NNO	
Solids, Dissolved	290.	10.	mg/L	1	160.1	04.10.01	I010024TDS	
Solids, total	230.	10.	mg/L	1	160.3	04.16.01	I010005TS	
Sulfate	14.	0.5	mg/L	1	300.0	04.24.01	I010055IC	
Total Kjeldahl Nitrogen	0.7	0.1	mg/L	1	351.3	04.10.01	I010031TKN	

LAB NUMBER: B040152-9

SAMPLE ID: EN-SP-B

SAMPLED: 04 APR 01

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	1
Calcium, dissolved	8.6	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Iron, dissolved	J0.02	0.05	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	1
Magnesium, dissolved	3.1	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Manganese, dissolved	J0.003	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Mercury, Trace Level	4.9	0.5	ng/L	1	1631	04.17.01	A010354MER	3
Potassium, dissolved	J0.4	1.	mg/L	1	200.7	04.16.01	A010345ICP	1,2

1) Sample Preparation on 04-13-01 using 200.2 (Filtrate)

2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

3) Sample Preparation on 04-16-01 using 1631





## ENVIRONMENTAL ANALYSES

LAB ORDER No.:

B040152

## INORGANIC ANALYTICAL RESULTS

Page 4 of 9

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040152-4 (continued)								
Potassium, dissolved	1.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Selenium, dissolved	JO.003	0.01	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Sodium, dissolved	5.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	1

LAB NUMBER: B040152-5

SAMPLE ID: BB-SP-S

SAMPLED: 03 APR 01

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	04.16.01	A010345ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	04.16.01	A010345ICP	1
Calcium, dissolved	26.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1
Iron, dissolved	ND	0.05	mg/L	1	200.7	04.16.01	A010345ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	04.16.01	A010345ICP	1
Magnesium, dissolved	12.	0.5	mg/L	1	200.7	04.16.01	A010345ICP	1
Manganese, dissolved	JO.002	0.005	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Mercury, Trace Level	5.0	0.5	ng/L	1	1631	04.17.01	A010354MER	3
Potassium, dissolved	1.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Selenium, dissolved	JO.002	0.01	mg/L	1	200.7	04.16.01	A010345ICP	1,2
Sodium, dissolved	15.	1.	mg/L	1	200.7	04.16.01	A010345ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	04.16.01	A010345ICP	1
Solids, Suspended	ND	3.	mg/L	1	160.2	04.10.01	B010102TSS	
ALKALINITY				1	310.1	04.05.01	I010018ALK	
Bicarbonate as CaCO3	120.	10.	mg/L					
Hydroxide as CaCO3	ND	10.	mg/L					
Carbonate as CaCO3	ND	10.	mg/L					
Total Alkalinity as CaCO3	120.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	04.10.01	I010043AMM	
Chloride	12.	5.	mg/L	5	300.0	04.26.01	I010057IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	04.27.01	I010019NNO	
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	04.10.01	I010029PHO	
Solids, Dissolved	180.	10.	mg/L	1	160.1	04.10.01	I010024TDS	
Solids, total	180.	10.	mg/L	1	160.3	04.16.01	I010005TS	
Sulfate	15.	0.5	mg/L	1	300.0	04.24.01	I010055IC	
Total Kjeldahl Nitrogen	0.3	0.1	mg/L	1	351.3	04.10.01	I010031TKN	

1) Sample Preparation on 04-13-01 using 200.2 (Filtrate)

2) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).

3) Sample Preparation on 04-16-01 using 1631



INORGANIC ANALYTICAL RESULTS

LAB ORDER No.:

B080129  
Page 2 of 7

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B080129-1								
SAMPLE ID: BB-SU-S								
SAMPLED: 31 JUL 01 10:00								
Mercury, Trace Level	0.0021	0.0005	ug/L	1	1631	08.10.01	A010764MER	1
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	08.06.01	B010221COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	
ALKALINITY				1	310.1	08.14.01	I010038ALK	
Bicarbonate as CaCO <sub>3</sub>	130.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	130.	10.	mg/L					
Ammonia as N	0.1	0.1	mg/L	1	350.2	08.09.01	I010087AMM	
Chloride	20.	10.	mg/L	10	300.0	08.28.01	I010121IC	
Nitrate + Nitrite as N	ND	0.1	mg/L	1	353.2	08.09.01	I010032NNO	
Phosphate as P, Total	ND	0.1	mg/L	1	365.2	08.10.01	I010088PHO	
Solids, Dissolved	180.	10.	mg/L	1	160.1	08.07.01	I010053TDS	
Solids, Total	190.	10.	mg/L	1	160.3	08.07.01	I010015TS	
Sulfate	13.	0.5	mg/L	1	300.0	08.28.01	I010121IC	
Total Kjeldahl Nitrogen	0.2	0.1	mg/L	1	351.3	08.06.01	I010060TKN	

LAB NUMBER: B080129-3

SAMPLE ID: BB-SU-I-1

SAMPLED: 31 JUL 01 11:30

Arsenic, dissolved	ND	0.004	mg/L	1	200.7	08.13.01	A010760ICP	2
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	08.13.01	A010760ICP	2
Calcium, dissolved	34.	0.5	mg/L	1	200.7	08.14.01	A010760ICP	2
Chromium, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2
Copper, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2
Iron, dissolved	ND	0.05	mg/L	1	200.7	08.13.01	A010760ICP	2
Lead, dissolved	ND	0.003	mg/L	1	200.7	08.13.01	A010760ICP	2
Magnesium, dissolved	14.	0.5	mg/L	1	200.7	08.13.01	A010760ICP	2
Manganese, dissolved	J0.002	0.005	mg/L	1	200.7	08.13.01	A010760ICP	2,3
Potassium, dissolved	2.	1.	mg/L	1	200.7	08.13.01	A010760ICP	2
Selenium, dissolved	ND	0.001	mg/L	1	270.3	08.14.01	A010768FIA	4
Sodium, dissolved	17.	1.	mg/L	1	200.7	08.13.01	A010760ICP	2
Zinc, dissolved	ND	0.02	mg/L	1	200.7	08.13.01	A010760ICP	2
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	

- 1) Sample Preparation on 08-09-01 using 1631
- 2) Sample Preparation on 08-09-01 using 200.2 (Filtrate)
- 3) A "J" flagged result reflects a value seen below the Reporting Limit (RL), but above the Method Detection Limit (MDL).
- 4) Sample Preparation on 08-13-01 using 3010





## ENVIRONMENTAL ANALYSES

LAB ORDER No.:

B080129

## INORGANIC ANALYTICAL RESULTS

Page 3 of 7

ANALYTE	RESULT	R.L.	UNITS	D.F.	METHOD	ANALYZED	QC BATCH	NOTES
ALKALINITY				1	310.1	08.06.01	I010035ALK	
Bicarbonate as CaCO <sub>3</sub>	150.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	150.	10.	mg/L					
Chloride	15.	1.	mg/L	1	300.0	08.28.01	I010121IC	
Solids, Dissolved	190.	10.	mg/L	1	160.1	08.07.01	I010053TDS	
Solids, Total	190.	10.	mg/L	1	160.3	08.07.01	I010015TS	
Sulfate	9.8	0.5	mg/L	1	300.0	08.28.01	I010121IC	

LAB NUMBER: B080129-4

SAMPLE ID: BB-SU-B

SAMPLED: 31 JUL 01 10:30

Arsenic, dissolved	0.007	0.004	mg/L	1	200.7	08.13.01	A010760ICP	1
Cadmium, dissolved	ND	0.001	mg/L	1	200.7	08.13.01	A010760ICP	1
Calcium, dissolved	34.	0.5	mg/L	1	200.7	08.14.01	A010760ICP	1
Chromium, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Copper, dissolved	ND	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Copper, dissolved	0.07	0.05	mg/L	1	200.7	08.13.01	A010760ICP	1
Lead, dissolved	ND	0.003	mg/L	1	200.7	08.13.01	A010760ICP	1
Magnesium, dissolved	15.	0.5	mg/L	1	200.7	08.13.01	A010760ICP	1
Manganese, dissolved	0.32	0.005	mg/L	1	200.7	08.13.01	A010760ICP	1
Mercury, Trace Level	0.0090	0.0005	ug/L	1	1631	08.10.01	A010764MER	2
Potassium, dissolved	2.	1.	mg/L	1	200.7	08.13.01	A010760ICP	1
Selenium, dissolved	0.002	0.001	mg/L	1	270.3	08.14.01	A010768FIA	3
Sodium, dissolved	16.	1.	mg/L	1	200.7	08.13.01	A010760ICP	1
Zinc, dissolved	ND	0.02	mg/L	1	200.7	08.13.01	A010760ICP	1

LAB NUMBER: B080129-5

SAMPLE ID: NH-SU-S

SAMPLED: 01 AUG 01 10:00

Mercury, Trace Level	0.0015	0.0005	ug/L	1	1631	08.10.01	A010764MER	2
Chemical Oxygen Demand	ND	50.	mg/L	1	410.4	08.06.01	B010221COD	
Solids, Suspended	ND	3.	mg/L	1	160.2	08.06.01	B010223TSS	
ALKALINITY				1	310.1	08.14.01	I010038ALK	
Bicarbonate as CaCO <sub>3</sub>	80.	10.	mg/L					
Hydroxide as CaCO <sub>3</sub>	ND	10.	mg/L					
Carbonate as CaCO <sub>3</sub>	ND	10.	mg/L					
Total Alkalinity as CaCO <sub>3</sub>	80.	10.	mg/L					
Ammonia as N	ND	0.1	mg/L	1	350.2	08.09.01	I010087AMM	
Chloride	4.	1.	mg/L	1	300.0	08.29.01	I010121IC	

- 1) Sample Preparation on 08-09-01 using 200.2 (Filtrate)
- 2) Sample Preparation on 08-09-01 using 1631
- 3) Sample Preparation on 08-13-01 using 3010



## **VI Fish Tissue**

## 2001 Fish Tissue Results

The following table provides an overview of the lab results for the 2001 fish tissue program. N/A indicates data is not available due to lack of fish collection. Sample Preparation, filleting and Extraction were in accordance with EPA 823-R-95-007, Sep 95, Volume 1, Section 7.2 (Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisory) which requires the following: Only the edible portion of the fillet shall be analyzed (i.e no skin, tail, fin, head). Tissue digestion shall be accomplished by adding concentrated nitric acid and heating the tube in an aluminum block to reflux the acid. The digestate shall be cooled, diluted to a final volume of 25 ml and analyzed by CVAA. The laboratory conducting the preparation and analysis was Toxscan, Inc in Watsonville, CA and the laboratory mercury analysis was in accordance with CVAA per EPA 7471. The Percent Lipids were per EPA 1664. The FDA criteria for a fish advisory is 1 ppm. The EPA's action level to continue fish tissue monitoring is 0.3 ppm.

Lake	Type of Fish	Type of Analysis (number of fish)	Date collected	Percent Lipids	Total Mercury	FDA Criteria
Black Butte	Lg M Bass	Composite (3)	8/29/01	0.12	0.58	1 ppm
Eastman	Note 4	-	-	-	-	1 ppm
Englebright	Sm M Bass	Composite (2)	8/4/01	0.12	0.25	1 ppm
Hensley	Sm M Bass	Composite (2)	1/30/02	0.079	0.30	1 ppm
Isabella	Note 5	-	-	-	-	1 ppm
Kaweah	Blk Bass	Composite (3)	9/28/01	0.76	0.40	1 ppm
Martis Cr	Note 4	-	-	-	-	-
Mendocino	Lg M Bass	Composite (3)	9/25/01	1.4	0.34	1 ppm
New Hogan	Lg M Bass	Composite (3)	8/14/01	0.75	0.60	1 ppm
Pine Flat	Spotted Bass	Composite (3)	7/08/01	0.53	0.23	1 ppm
Sonoma	Lg M Bass	Composite (3)	11/08/01	0.058	0.43	1 ppm
Success	Blk Bass	Composite (3)	9/10/01	0.44	0.29	1 ppm

Notes:

1. Non-Detect is indicated by "<0.02" since the lab Detection Limit is 0.02 ppm.
2. Total Mercury was reported in mg/L or ppm.
3. Total Mercury was conducted instead of Methyl Mercury since EPA 832 allows Total Mercury analysis for an initial screening program. When specific problem areas are identified, methyl mercury analysis are normally performed later as part of the actual health risk assessment.
4. The fish tissue program was terminated at Eastman and Martis Creek in 2001 due to low total mercury results in 2000. In 2000, the total mercury was only 0.089 ppm for Eastman (Catfish) and the total mercury was <0.02 ppm for Martis Creek (Brown Trout).
5. Due to seasonal conditions, a fish could not be successfully collected at Lake Isabella. Another attempt will be accomplished for the 2002 report.

The above 2001 total mercury results indicate only New Hogan and Black Butte are relatively higher than average. However, in 2000, the total mercury results were only 0.52 ppm for New Hogan (catfish) and only 0.37 ppm for Black Butte (catfish). The 2002 fish tissue program should provide additional data. The attached EPA fact sheet on fish advisory indicates that the mean average mercury results from numerous lakes in the Northeast United States were found to be 0.46-0.51 ppm for largemouth bass and 0.34-0.53 for smallmouth bass.



42 Hangar Way • Watsonville, CA 95076-2404 • (831) 724-4522 • FAX (831) 724-3188

October 22, 2001

ToxScan Number: T-19774

U.S. Army Corps of Engineers, Sacramento District  
1325 "J" Street  
Sacramento, CA 95814-2922

Attn: Vic Chan

Project Name: 2001 Lake Monitoring  
Project Number: Black Butte Lake  
Date Sampled: August 29, 2001  
Date Received: September 27, 2001  
Matrix: Fish Tissue

Please find the enclosed test results for the parameters requested for analyses. The sample was analyzed within holding time using the following methods:

Percent Lipids by EPA Method 1664  
Total Mercury by Cold Vapor AA by EPA Method 7471M

The sample was received intact and was handled with the proper chain-of-custody procedures. Appropriate QA/QC guidelines were employed during the analyses on a minimum of a 5% basis. QC results were within limits and are reported with or following the data for each analysis.

If you have any questions or require any additional information, please feel free to call.

Sincerely,

Philip D. Carpenter, Ph.D.  
President

Enclosures

*This cover letter is an integral part of the report.*

Client: U.S. Army Corps of Engineers, Sacramento District  
Method: EPA Method(s) 1664  
Date Completed: 10/12/2001  
Matrix: Fish Tissue  
Units: Percent

ToxScan Number: T-19774

<b>Client</b>	<b>ToxScan</b>		<b>Sample</b>	<b>Reporting</b>
<b><u>Sample ID</u></b>	<b><u>Lab ID</u></b>	<b><u>Analyte</u></b>	<b><u>Value</u></b>	<b><u>Limit</u></b>
BB-010829-F1,F2,F3 Composite	19774-04	Percent Lipids	0.12	0.10



Client: U.S. Army Corps of Engineers, Sacramento District  
Method: EPA Method(s) 7471  
Date Completed: 10/19/2001  
Matrix: Fish Tissue  
Units: mg/Kg

ToxScan Number: T-19774

Total Metals

<b>Client</b> <b><u>Sample ID</u></b>	<b>ToxScan</b> <b><u>Lab ID</u></b>	<b><u>Analyte</u></b>	<b>Sample</b> <b><u>Value</u></b>	<b>Reporting</b> <b><u>Limit</u></b>
BB-010829-F1,F2,F3 Composite	19774-04	Mercury	0.58	0.020

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United States  
Environmental Protection  
Agency

Office of Water  
4305

EPA-823-F-99-016  
September 1999

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## Mercury Update: Impact on Fish Advisories

### *Summary*

*Mercury is distributed throughout the environment from both natural sources and human activities. Methylmercury is the main form of organic mercury found in the environment and is the form that accumulates in both fish and human tissues. Three major episodes of methylmercury poisoning through consumption of contaminated food have occurred; these resulted in central nervous system effects such as impairment of peripheral vision, mental symptoms, loss of feeling, and, at high doses, seizures, very severe neurological impairment, and death. Methylmercury has also been shown to be a developmental toxicant, causing subtle to severe neurological effects. EPA considers there is sufficient evidence for methylmercury to be considered a developmental toxicant, to be of concern for potential human mutagenicity, and to be a possible human carcinogen (Group C). As of December 1998, 40 states have issued 1,931 fish advisories for mercury. These advisories inform the public that concentrations of mercury have been found in local fish at levels of public health concern. State advisories recommend either limiting or avoiding consumption of certain fish from specific waterbodies or, in some cases, from specific waterbody types (e.g., all freshwater lakes or rivers).*

The purpose of this fact sheet is to summarize current information on sources, fate and transport, occurrence in human tissues, range of concentrations in fish tissue, fish advisories, fish consumption limits, toxicity, and regulations for mercury. The fact sheets also illustrate how this information may be used for developing fish consumption advisories. An electronic version of this fact sheet and fact sheets for dioxins/furans, PCBs, and toxaphene are available at <http://www.epa.gov/OST/fish>. Future revisions will be posted on the web as they become available.

### **Sources of Mercury in the Environment**

Mercury is found in the environment in the metallic form and in different inorganic and organic forms. Most of the mercury in the atmosphere is elemental mercury vapor; most of the mercury in water, soil, plants, and animals is inorganic and organic mercury (primarily methylmercury).

Mercury occurs naturally and is distributed throughout the environment by both natural

processes and human activities. Solid waste incineration and fossil fuel combustion facilities contribute approximately 87% of the emissions of mercury in the United States. Other sources of mercury releases to the air include mining and smelting, industrial processes involving the use of mercury such as chlor-alkali production facilities and production of cement.

Mercury is released to surface waters from naturally occurring mercury in rocks and soils and from industrial activities, including pulp and paper mills, leather tanning, electroplating, and chemical manufacturing. Wastewater treatment facilities may also release mercury to water. An indirect source of mercury to surface waters is mercury in the air; it is deposited from rain and other processes directly to water surfaces and to soils. Mercury also may be mobilized from sediments if disturbed (e.g., flooding, dredging).

Sources of mercury in soil include direct application of fertilizers and fungicides and disposal of solid waste, including batteries and thermometers, to landfills. The disposal of municipal incinerator ash in landfills and the application of sewage sludge to crop land result in increased levels of mercury in soil. Mercury in air may also be deposited in soil and sediments.

### **Fate and Transport of Mercury**

The global cycling of mercury is a complex process. Mercury evaporates from soils and surface waters to the atmosphere, is redeposited on land and surface water, and then is absorbed by soil or sediments. After redeposition on land and water, mercury is commonly volatilized back to the atmosphere as a gas or as adherents to particulates.

Mercury exists in a number of inorganic and organic forms in water. Methylmercury, the most common organic form of mercury, quickly enters the aquatic food chain. In most adult fish, 90% to 100% of the mercury is methylmercury. Methylmercury is found primarily in the fish muscle (fillets) bound to proteins.

Skinning and trimming the fish does not significantly reduce the mercury concentration in the fillet, nor is it removed by cooking processes. Because moisture is lost during cooking, the concentration of mercury after cooking is actually higher than it is in the fresh uncooked fish.

Concentrations of total mercury in fish at the top of the food chain, such as pike, shark, and swordfish, are approximately 10,000 to 100,000 times higher than the concentrations of inorganic mercury found in the surrounding waters. The bioconcentration factor (BCF) of methylmercury in fish is on the order of 3 million. The bioaccumulation of methylmercury is even greater. Methylmercury levels in predator fish are, on average, approximately 7 million times higher than the concentrations of dissolved methylmercury found in the surrounding waters.

In 1984 and 1985, the U.S. Fish and Wildlife Service collected 315 composite samples of whole fish from 109 stations nationwide as part of the National Contaminant Biomonitoring Program (NCBP). The maximum, geometric mean, and 85th percentile concentrations for mercury were 0.37, 0.10, and 0.17 ppm (wet weight), respectively. An analysis of mercury levels in tissues of bottom-feeding and predatory fish using the data

from the NCBP study showed that the mean mercury tissue concentration of  $0.12 \pm 0.08$  ppm in predatory fish species (e.g., trout, walleye, largemouth bass) was significantly higher than the mean tissue concentration of  $0.08 \pm 0.06$  ppm in bottom feeders (e.g., carp, white sucker, and channel catfish).

Mercury, the only metal analyzed as part of EPA's 1987 National Study of Chemical Residues in Fish (NSCRF), was detected at 92% of 374 sites surveyed. Maximum, arithmetic mean, and median concentrations in fish tissue were 1.77, 0.26, and 0.17 ppm (wet weight), respectively. Mean mercury concentrations in bottom feeders (whole body samples) were generally lower than concentrations for predator fish (fillet samples) (see Table 1). Most of the higher tissue concentrations of mercury were detected in freshwater fish samples collected in the Northeast.

Most recently, the northeast states and eastern Canadian provinces issued their own mercury study, including a comprehensive analysis of mercury concentrations in a variety of freshwater sportfish collected from the late 1980s to 1996. Top level predatory fish such as walleye, chain pickerel, and large and smallmouth bass were typically found to exhibit the highest concentrations, with mean tissue residues greater than 0.5 ppm and maximum residues exceeding 2 ppm. One largemouth bass sample was found to contain 8.94 ppm of mercury, while a smallmouth bass sampled contained 5 ppm. Table 2 summarizes the range and the mean concentrations found in eight species of sportfish sampled.

Mercury has also been detected in marine fish species. Concentrations of methylmercury in muscle tissue in nine species of Atlantic shark averaged  $0.88 \mu\text{g/g}$  (ppm) (wet weight) and ranged from  $0.06$  to  $2.87 \mu\text{g/g}$  (ppm). Bluefin tuna from the northwest Atlantic Ocean contained mercury at a mean muscle concentration of  $3.41 \mu\text{g/g}$  (ppm)(dry weight).

**Table 1. Mean Mercury Concentration in Freshwater Fish\***

Species	Mean concentration (ppm)**
<b>Bottom Feeders</b>	
Carp	0.11
White sucker	0.11
Channel catfish	0.09
<b>Predator Fish</b>	
Largemouth bass	0.46
Smallmouth bass	0.34
Walleye	0.52
Brown trout	0.14

\*EPA National Study of Chemical Residues in Fish conducted in 1987; species included freshwater, estuarine, and marine finfish; and a small number of marine shellfish.

\*\*Concentration are reported on wet weight basis

Source: Bahnick et al., 1994

**Table 2. Mercury Concentration for Selected Fish Species in the Northeast**

<b>Species</b>	<b>Mean concentration* (ppm)</b>	<b>Minimum-maximum range* (ppm)</b>
Largemouth bass	0.51	0-8.94
Smallmouth bass	0.53	0.08-5.0
Yellow perch	0.40	0-3.15
Eastern chain pickerel	0.64	0-2.81
Lake trout	0.32	0-2.70
Walleye	0.77	0.10-2.04
Brown bullhead	0.20	0-1.10
Brook trout	0.26	0-0.98

\*Concentration are reported on a wet weight basis.

Source: NESCAUM, 1998.

Because of the higher cost of methylmercury analysis, EPA recommends that total mercury rather than methylmercury concentrations be determined in state fish contaminant monitoring programs. EPA also recommends that the conservative assumption be made that all mercury is present as methylmercury in order to be most protective of human health.

### **Potential Sources of Exposure and Occurrence in Human Tissues**

Potential sources of human exposure to mercury include food contaminated with mercury, inhalation of mercury vapors in ambient air, and exposure to mercury through dental and medical treatments. Dietary intake is by far the most important source of exposure to mercury for the general population. Fish and other seafood products are the main source of methylmercury in the diet; studies have shown that methylmercury concentrations in fish and shellfish are approximately 10 to 100 times greater than in other foods, including cereals, potatoes, vegetables, fruits, meats, poultry, eggs, and milk.

Individuals who may be exposed to higher than average levels of methylmercury include recreational and subsistence fishers who routinely consume large amounts of locally caught fish and subsistence hunters who routinely consume the meat and organ tissues of marine mammals.

Analytical methods are available to measure mercury in blood, urine, tissue, hair, and breast milk.

### **Fish Advisories**

The states have primary responsibility for protecting their residents from the health risks of consuming contaminated noncommercially caught fish. They do this by issuing consumption advisories for the general population, including recreational and subsistence fishers, as well as sensitive subpopulations (such as pregnant women/fetus, nursing

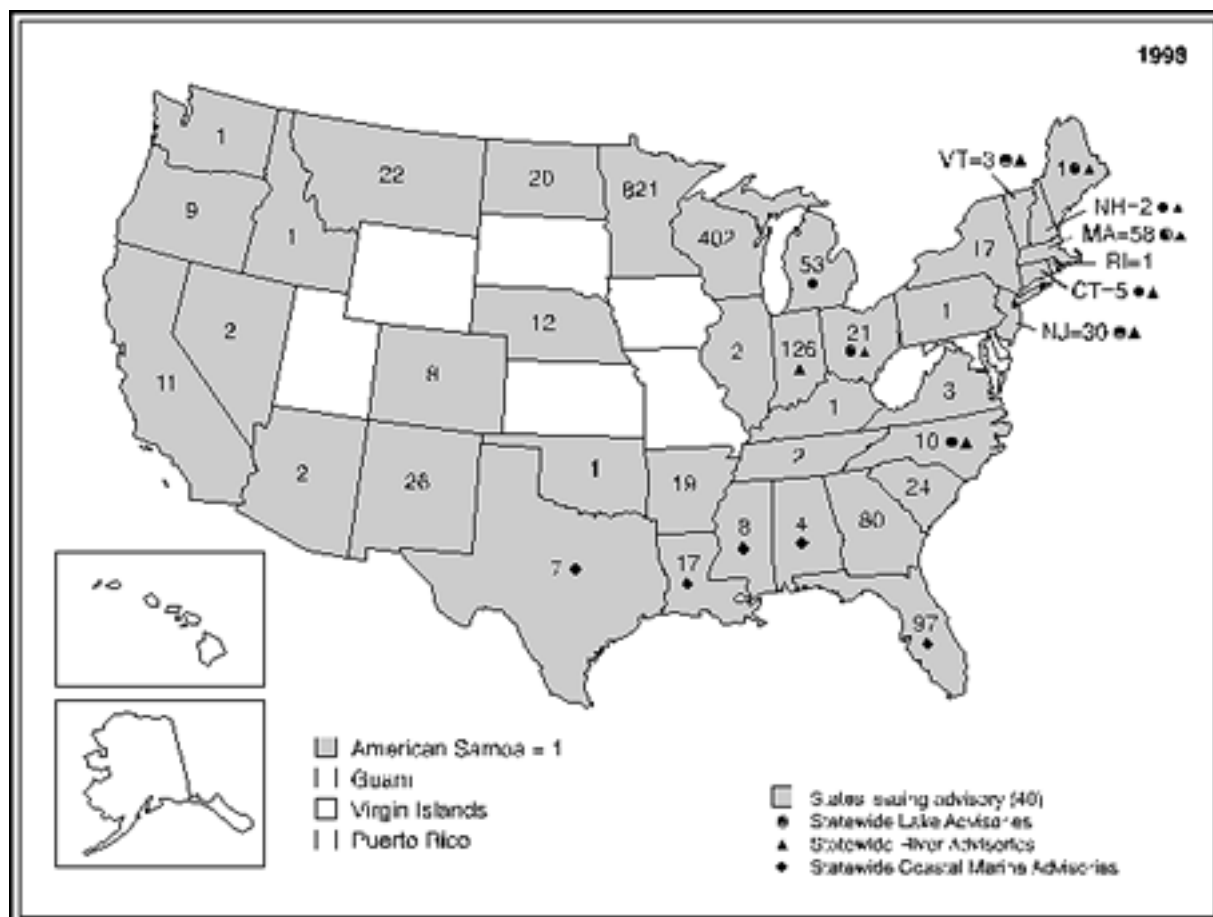
mothers and their infants, and children). These advisories inform the public that high concentrations of chemical contaminants, such as mercury, have been found in local fish. The advisories recommend either limiting or avoiding consumption of certain fish from specific waterbodies or, in some cases, from specific waterbody types (such as lakes or rivers).

As of December 1998, mercury was the chemical contaminant responsible, at least in part, for the issuance of 1,931 fish consumption advisories by 40 states, including the U.S. territory of American Samoa. Almost 68% of all advisories issued in the United States are a result of mercury contamination in fish and shellfish. Advisories for mercury have increased steadily, by 115% from 899 advisories in 1993 to 1,931 advisories in 1998. The number of states that have issued mercury advisories also has risen steadily from 27 states in 1993 to 40 states in 1997, and remains at 40 states for 1998. Advisories for mercury increased nearly 8% from 1997 (1,782 advisories) to 1998 (1,931 advisories).

Ten states have issued statewide advisories for mercury in their freshwater lakes and/or rivers: Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, North Carolina, Ohio, and Vermont. Another five Gulf Coast states (Alabama, Florida, Louisiana, Mississippi, and Texas) have statewide mercury advisories in effect for their coastal marine waters. To date, 90% of the 1,931 mercury advisories in effect have been issued by the following 11 states; Minnesota (821), Wisconsin (402), Indiana (126), Florida (97), Georgia (80), Massachusetts (58), Michigan (53), New Jersey (30), New Mexico (26), South Carolina (24), and Montana (22). Figure 1 shows the total number of fish advisories for mercury in each state in 1998.

### **Figure 1. Fish Advisories for Mercury**





**Fish Consumption Limits**—EPA indicated in the *Mercury Study Report to Congress* (U.S. EPA, 1997) that the typical U.S. consumer was not in danger of consuming harmful levels of methylmercury from fish and was not advised to limit fish consumption on the basis of mercury content. This advice is appropriate for typical consumers who eat less than 10 grams of fish and shellfish per day with mercury concentrations averaging between 0.1 and 0.15 ppm, which are typical for most species of commercially obtained fish. At these rates of fish intake, methylmercury exposures are considerably less than the interim reference dose (RfD) of  $1 \times 10^{-4}$  mg/kg-d. However, eating more fish than is typical or eating fish that are more contaminated, can increase the risk to a developing fetus.

Two groups of women of childbearing age are of concern: (1) those who eat more than 10 grams of fish a day and (2) those who eat fish with higher methylmercury levels. Ten grams of fish is a little over one-quarter cup of tuna per week or about one fish sandwich per week. Based on diet surveys, 10% of women of childbearing age eat five times or more fish than does the average consumer. If the fish have average mercury concentrations of 0.1 to 0.15 ppm, the women's mercury exposures range from near or slightly over the interim RfD to about twice the interim RfD.

The second group of women of concern are those who eat fish with higher mercury concentrations (e.g., 0.5 ppm and higher). Examples of fish with above average mercury levels are king mackerel, various bass species, orange roughy, pike, swordfish, shark and freshwater fish from contaminated waters. Even women eating average amounts of fish (i.e., <10 g/d) have mercury exposures near the interim RfD, if the mercury concentration

is 0.5 ppm. If women eat these fish species and their average fish intake is between 40 and 70 grams/day (or about a quarter cup per day), their mercury exposures would range from three to six times the interim RfD. Consumers who eat fish with 1 ppm mercury (e.g., swordfish and shark) at the level of 40 to 70 g/d have intakes that range from 6 to nearly 12 times the interim RfD.

Some women of childbearing age in certain ethnic groups (Asians, Pacific Islanders, and Native Americans) eat much more fish than the general population. Because of the higher amounts of fish in their diets, women in these ethnic groups need to be aware of the level of mercury in the fish they eat.

The RfD is not a "bright line" between safety and toxicity; however, there is progressively greater concern about the likelihood of adverse effects above this level. Consequently, people are advised to consume fish in moderate amounts and be aware of the amount of mercury in the fish they eat.

For sensitive populations, such as pregnant women, nursing mothers, and young children, some states have issued either "no consumption" advisories or "restricted consumption" advisories for methyl-mercury. Additional information on calculating specific limits for these sensitive populations is available in EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2, Section 3.

Table 3 shows the recommended monthly fish consumption limits for methylmercury in fish for fish consumers based on EPA's default values for risk assessment parameters. Consumption limits have been calculated as the number of allowable fish meals per month based on the ranges of methylmercury in the consumed fish tissue. The following assumptions were used to calculate the consumption limits:

- Consumer adult body weight of 72 kg
- Average fish meal size of 8 oz (0.227 kg)
- Time-averaging period of 1 mo (30.44 d)
- EPA's interim reference dose for methylmercury ( $1 \times 10^{-4}$  mg/kg-d) from EPA's
- Integrated Risk Information System (U.S. EPA, 1999c).

For example, when methylmercury levels in fish tissue are 0.4 ppm, then two 8-oz. meals per month can safely be consumed.

**Table 3. Monthly Fish Consumption Limits for Methylmercury**

<b>Risk-based consumption limit</b>	<b>Noncancer health endpoints</b>
<b>Fish meals/month</b>	<b>Fish tissue concentrations (ppm, wet weight)</b>
16	> 0.03–0.06
12	> 0.06–0.08
8	> 0.08–0.12
4	> 0.12–0.24



3	> 0.24–0.32
2	> 0.32–0.48
1	> 0.48–0.97
0.5	> 0.97–1.9
None (<0.5)*	> 1.9

\*None = No consumption recommended.

NOTE: In cases where >16 meals per month are consumed, refer to EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*, Volume 2, Section 3 for methods to determine safe consumption limits.

## Toxicity of Mercury

**Pharmacokinetics**—Methylmercury is rapidly and nearly completely absorbed from the gastrointestinal tract; 90% to 100% absorption is estimated. Methylmercury is somewhat lipophilic, allowing it to pass through lipid membranes of cells and facilitating its distribution to all tissues, and it binds readily to proteins. Methylmercury binds to amino acids in fish muscle tissue.

The highest methylmercury levels in humans are generally found in the kidneys. Methylmercury in the body is considered to be relatively stable and is only slowly transformed to form other forms of mercury. Methylmercury readily crosses the placental and blood/brain barriers. Estimates for its half-life in the human body range from 44 to 80 days.

Excretion of methylmercury is via the feces, urine, and breast milk. Methylmercury is also distributed to human hair and to the fur and feathers of wildlife; measurement of mercury in hair and these other tissues has served as a useful biomonitor of contamination levels.

**Acute Toxicity**—Acute high-level exposures to methylmercury may result in impaired central nervous system function, kidney damage and failure, gastrointestinal damage, cardiovascular collapse, shock, and death. The estimated lethal dose is 10 to 60 mg/kg.

**Chronic Toxicity**—Although both elemental mercury and methylmercury produce a variety of health effects at relatively high exposures, neurotoxicity is the effect of greatest concern. This is true whether exposure occurs to the developing embryo or fetus during pregnancy or to adults and children. Human exposure to methylmercury has generally been through consumption of contaminated food. Two major episodes of methylmercury poisoning through fish consumption have occurred. The first occurred in the early 1950s among people, fish consuming domestic animals such as cats, and wildlife living near Minamata City on the shores of Minamata Bay, Kyushu, Japan. The source of the methylmercury contamination was effluent from a chemical factory that used mercury as a catalyst and discharged wastes into the bay where it accumulated in fish and shellfish that were a dietary staple of this population. Average fish consumption was reported to be in excess of 300 g/d, 20 times greater than is typical for recreational fishers in the United States.

By comparison, about 3% to 5% of U.S. consumers routinely eat 100 grams of fish per day. Among women of childbearing age, 3% routinely eat 100 grams of fish per day.

In 1965, another methylmercury poisoning incident occurred in the area of Niigata, Japan. The signs and symptoms of the disease in Niigata were similar to those of methylmercury poisoning in Minamata.

**Symptoms of Minamata disease** in children and adults included: impairment of peripheral vision, disturbances in sensations ("pins and needles" feelings, numbness) usually in the hands and feet and sometimes around the mouth; incoordination of movements; impairment of speech, hearing, and walking; and mental disturbances. It sometimes took several years before individuals were aware that they were developing the signs and symptoms of methylmercury poisoning. Over the years, it became clear that nervous system damage could occur to a fetus whose mother ate fish contaminated with methylmercury during the pregnancy.

Methylmercury poisoning also occurred in Iraq following consumption of seed grain that had been treated with a fungicide containing methylmercury. The first outbreak occurred prior to 1960; the second occurred in the early 1970s. Imported mercury-treated seed grains that arrived after the planting season were ground into flour and baked into bread. Unlike the long-term exposures in Japan, the epidemic of methylmercury poisoning in Iraq was short in duration lasting approximately 6 months. The signs and symptoms of disease in Iraq were predominantly in the nervous system: difficulty with peripheral vision or blindness, sensory disturbances, incoordination, impairment of walking, and slurred speech. Both children and adults were affected. Infants born to mothers who had consumed methylmercury contaminated grain (particularly during the second trimester of pregnancy) showed nervous system damage even though the mother was only slightly affected.

**Recent studies** have examined populations that are exposed to lower levels of methylmercury as a consequence of routine consumption of fish and marine mammals including studies of populations around the Great Lakes and in New Zealand, the Amazon basin, the Seychelles Islands, and the Faroe Islands. The last two studies are of large populations of children presumably exposed to methylmercury in utero. Very sensitive measures of developmental neurotoxicity in these populations are still being analyzed and published. A recent workshop discussed these studies and concluded that they have provided valuable new information on the potential health effects of methylmercury. Significant uncertainties remain, however, because of issues related to exposure, neurobehavioral endpoints, confounders and statistics, and study design.

***Developmental Toxicity***—Data are available on developmental effects in rats, mice, guinea pigs, hamsters, and monkeys. Also, convincing data from a number of human studies (i.e., Minamata, Iraq) indicate that methylmercury causes subtle to severe neurologic effects depending on dose and individual susceptibility. EPA considers methylmercury to have sufficient human and animal data to be classified as a developmental toxicant.

Methylmercury accumulates in body tissue; consequently, maternal exposure occurring prior to pregnancy can contribute to the overall maternal body burden and result in exposure to the developing fetus. In addition, infants may be exposed to methylmercury through breast milk. Therefore, it is advisable to reduce methylmercury exposure to women with childbearing potential to reduce overall body burden (see Fish Consumption Limits section).

***Mutagenicity***—Methylmercury appears to be clastogenic but not to be a point mutagen; that is, mercury causes chromosome damage but not small heritable changes in DNA.

EPA has classified methylmercury as being of high concern for potential human germ cell mutagenicity. The absence of positive results in a heritable mutagenicity assay keeps methylmercury from being included under the highest level of concern. The data on mutagenicity are not sufficient, however, to permit estimation of the amount of methylmercury that would cause a measurable mutagenic effect in the human population.

***Carcinogenicity***—Experimental animal data suggest that methylmercury may be tumorigenic in animals. Chronic dietary exposures of mice to methylmercury resulted in significant increases in the incidences of kidney tumors in males but not in females. The tumors were seen only at toxic doses of methylmercury. Three human studies have been identified that examined the relationship between methylmercury exposure and cancer. There was no persuasive evidence of increased carcinogenicity attributable to methylmercury exposure in any of these studies. Interpretation of these studies was limited by poor study design and incomplete descriptions of methodology and/or results. EPA has not calculated quantitative carcinogenic risk values for methylmercury. EPA has found methylmercury to have inadequate data in humans and limited evidence in animals, and has classified it as a possible human carcinogen, Group C.

All of the carcinogenic effects in animals were observed in the presence of profound damage to the kidneys. Tumors may be formed as a consequence of repair in the damaged organs. Evidence points to a mode of action for methylmercury carcinogenicity that operates at high doses certain to produce other types of toxicity in humans. Given the levels of exposure most likely to occur in the U.S. population, even among consumers of large amounts of fish, methylmercury is not likely to present a carcinogenic risk.

### Summary of EPA Health Benchmarks

- Chronic Toxicity—Interim Reference Dose:  $1 \times 10^{-4}$  mg/kg-d (U.S. EPA, 1999c)
- Carcinogenicity: No carcinogenic risk values calculated

**Special Susceptibilities**—The developing fetus is at greater risk from methylmercury exposure than are adults. Data on children exposed only after birth are insufficient to determine if this group has increased susceptibility to the adverse central nervous system effects of methylmercury. In addition, children are considered to be at increased risk of methylmercury exposure by virtue of their greater food consumption as a percentage of body weight (mg food/kg body weight) compared to adult exposures. Additional risk from higher mercury ingestion rates may also result from the apparent decreased ability of children's bodies to eliminate mercury.

**Interactive Effects**—Potassium dichromate and atrazine may increase the toxicity of mercury, although these effects have been noted only with metallic and inorganic mercury. Ethanol increases the toxicity of methylmercury in experimental animals. Vitamins D and E, thiol compounds, selenium, copper, and possibly zinc are antagonistic to the toxic effects of mercury.

**Critical Data Gaps**—Additional data are needed on the exposure levels at which humans experience subtle, but persistent, adverse neurological effects. Data on immunologic effects and reproductive effects are not sufficient for evaluation of low-dose methylmercury toxicity for these endpoints.

### EPA Regulations and Advisories

- Maximum Contaminant Level in drinking water = 0.002 mg/L
- Toxic Criteria for those States Not Complying with CWA Section 303(c)(2)(B) - criterion concentration for priority toxic pollutants:
  - Freshwater: maximum = 2.10 µg/L, continuous = 0.012 µg/L
  - Saltwater: maximum = 1.80 µg/L, continuous = 0.025 µg/L
  - Human health consumption of water and organisms = 0.14 µg/L
  - Human health consumption of organisms only = 0.15 µg/L.
- Water Quality Guidance for the Great Lakes System — protection of aquatic life in ambient water:

- acute water quality criteria for mercury total recoverable: maximum = 1.694 µg/L
- chronic water quality criteria for mercury total recoverable: continuous = 0.908 µg/L
- water quality criteria for protection of human health, drinking water and nondrinking water: maximum =  $1.8 \times 10^{-3}$  µg/L
- water quality criteria for protection of human health (mercury including methylmercury) =  $1.3 \times 10^{-3}$  µg/L.
- Listed as a hazardous air pollutant under Section 112 of the Clean Air Act
- Emissions from mercury ore processing facilities and mercury chlor-alkali plants = 2,300 g maximum/24 h
- Emissions from sludge incineration plants, sludge drying plants, or a combination of these that process wastewater treatment plant sludge = 3,200 g maximum/24 h
- Ban of phenylmercuric acetate as a fungicide in interior and exterior latex paints
- Reportable quantities: Mercury, mercuric cyanide = 1 lb; mercuric nitrate, mercuric sulfate, mercuric thiocyanate, mercurous nitrate, mercury fulminate = 10 lb; phenylmercury acetate = 100 lb.
- Listed as a hazardous substance: Mercuric cyanide, mercuric nitrate, mercuric sulfate, mercuric thiocyanate, mercurous nitrate
- Reporting threshold for Toxic Release Inventory (proposed) = 10 lb

### Sources of Information

ATSDR (Agency for Toxic Substances and Disease Registry). 1999. *Toxicological Profile for Mercury*. U.S. Department of Health and Human Services, Public Health Service, Atlanta, GA.

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U.S. EPA (Environmental Protection Agency). IRIS (Integrated Risk Information System) for Methylmercury. 1999c. National Center for Environmental Assessment, Office of Research and Development, Cincinnati, OH.

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The 1998 update of the database *National Listing of Fish and Wildlife  
Advisories* is available for downloading from the following Internet  
site: <http://www.epa.gov/OST>

[OST HOME](#) | [EPA HOME](#) | [WATER HOME](#) | [COMMENTS](#) | [SEARCH](#)

URL: <http://www.epa.gov/OST/fish/mercury.html>  
Revised September 20, 1999

## **VII MTBE Results**



## 2001 MTBE Results

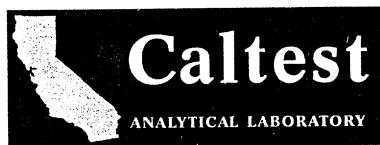
**Units are ug/L (ppb)**

The following table provides an overview of the lab results for the 2001 MTBE monitoring program.

Lake	Spring S	Spring S-1	Spring S-M	Spring S-C	Summer S	Summer S-1	Summer S-M	Summer S-C	Remarks
Black Butte	<2		<2		<2		<2		No MTBE
Eastman	0.4				3				
Englebright	<2	<2	<2	<2	<2		<2	<2	No MTBE
Hensley	1.5		1.7		2		3		
Isabella	1.4	1.3	18	0.8	3	3	3	3	Note 8
Kaweah	3		3	1.7	4		6	6	
Martis Cr.	<2				<2				No MTBE
Mendocino	<2				<2				No MTBE
New Hogan	<2				<2				No MTBE
Pine Flat	0.9		1		2		2		
Sonoma	1.9		1.6		<2		2		
Success	4		5	4	4	4	5	4	

**Notes:**

1. Non-Detect is indicated by "<2" since the Reporting Limit is 2 ppb or 0.002 ppm.
2. No enforceable acceptance criteria has been established for MTBE. See EPA Fact sheet.
3. Maps are provided to illustrate the sampling locations for samples: S / S-1, S-M, and S-C. Sample S and sample S1 are located near the dam; sample S-M is located within 50 ft of the Marina; and sample S-C is located near the center of the lake.
4. For 2001, the number of MTBE water sampling at each lake is based on last year's lab results.
5. 2 samples were taken from Eastman, Martis Creek, Mendocino, and New Hogan because MTBE was non-detectable for 2000. The 2001 results of non-detectable levels were similar except Lake Eastman now reported detectable levels of MTBE.
6. 4 samples were taken from Black Butte, Hensley, Pine Flat and Sonoma because relatively low detectable levels was found for 2000. The 2001 results were similar except Black Butte now reported non-detectible levels.
7. 6 to 8 samples were taken from Englebright, Isabella, Kaweah and Success because relatively higher MTBE was found for 2000. The 2001 results were similar except Englebright now reported non-detectible levels.
8. Very high MTBE was reported at Lake Isabella during the Spring for 2 straight years. During Spring 2000, Lake Isabella reported 21 ug/L. The 2001 results indicated that the high MTBE is restricted near the marina and during the Spring only. An on-site investigation will be conducted this Spring at Lake Isabella to determine the cause.



## ENVIRONMENTAL ANALYSES

LAB ORDER No.:

B080129

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## ORGANIC ANALYTICAL RESULTS

ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
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LAB NUMBER: B080129-1  
SAMPLE ID: BB-SU-S  
SAMPLED: 31 JUL 01 10:00  
METHOD: EPA 8260B

VOLATILE ORGANIC COMPOUNDS					1 08.14.01	V010059MSA	
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	ND	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	85.		%				
Surrogate 1,2-DCA-d4	82.		%				
Surrogate Toluene-d8	87.		%				
Surrogate 4-BFB	86.		%				

LAB NUMBER: B080129-2  
SAMPLE ID: BB-SU-SM  
SAMPLED: 31 JUL 01 10:10  
METHOD: EPA 8260B

VOLATILE ORGANIC COMPOUNDS					1 08.16.01	V010111MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	ND	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	121.		%				
Surrogate 1,2-DCA-d4	112.		%				
Surrogate Toluene-d8	113.		%				
Surrogate 4-BFB	126.		%				

LAB NUMBER: B080129-5  
SAMPLE ID: NH-SU-S  
SAMPLED: 01 AUG 01 10:00  
METHOD: EPA 8260B

VOLATILE ORGANIC COMPOUNDS					1 08.15.01	V010109MSB	2
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	ND	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	120.		%				

- 1) Sample Preparation on 08-16-01 using EPA 5030
- 2) Sample Preparation on 08-14-01 using EPA 5030



LAB ORDER No.:

B040076  
Page 3 of 3

ORGANIC ANALYTICAL RESULTS

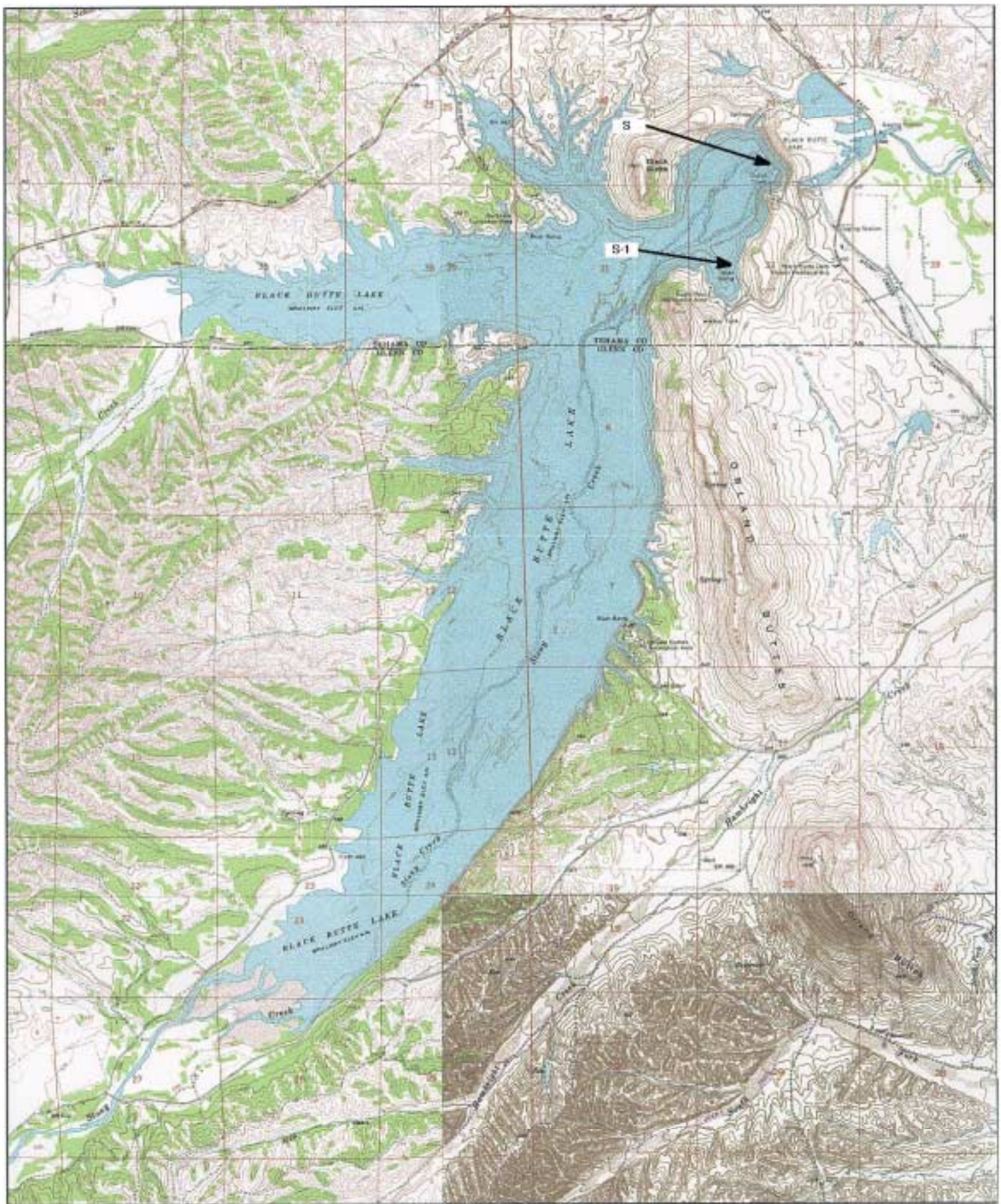
ANALYTE	RESULT	R.L.	UNITS	D.F.	ANALYZED	QC BATCH	NOTES
LAB NUMBER: B040076-1							
SAMPLE ID: BB-SP-S							
SAMPLED: 03 APR 01 11:00							
METHOD: EPA 8260B							
VOLATILE ORGANIC COMPOUNDS					1 04.10.01	V010051MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	ND	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	100.		%				
Surrogate 1,2-DCA-d4	98.		%				
Surrogate Toluene-d8	108.		%				
Surrogate 4-BFB	100.		%				

LAB NUMBER: B040076-2  
SAMPLE ID: BB-SP-SM  
SAMPLED: 03 APR 01 11:15  
METHOD: EPA 8260B

VOLATILE ORGANIC COMPOUNDS					1 04.10.01	V010051MSB	1
tert-Amyl-Methyl Ether (TAME)	ND	2.	ug/L				
Ethyl-tert-Butyl Ether (ETBE)	ND	1.	ug/L				
Diisopropyl Ether (DIPE)	ND	2.	ug/L				
Methyl tert-Butyl Ether (MTBE)	ND	2.	ug/L				
2-Methyl-2-Propanol (TBA)	ND	50.	ug/L				
Surrogate Dibromofluoromethane	104.		%				
Surrogate 1,2-DCA-d4	106.		%				
Surrogate Toluene-d8	107.		%				
Surrogate 4-BFB	98.		%				

1) Sample Preparation on 04-09-01 using EPA 5030









## FACT SHEET

# Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MtBE)

### The Advisory

The U.S. Environmental Protection Agency (EPA) Office of Water is issuing an Advisory on methyl tertiary-butyl ether (MtBE) in drinking water. This Advisory provides guidance to communities exposed to drinking water contaminated with MtBE. This document supersedes any previous drafts of drinking water health advisories for this chemical.

### What is an Advisory?

The U.S. EPA Health Advisory Program was initiated to provide information and guidance to individuals or agencies concerned with potential risk from drinking water contaminants for which no national regulations currently exist. Advisories are not mandatory standards for action. Advisories are used only for guidance and are not legally enforceable. They are subject to revision as new information becomes available. EPA's Health Advisory program is recognized in the Safe Drinking Water Act Amendments of 1996, which state in section 102(b)(1)(F):

"The Administrator may publish health advisories (which are not regulations) or take other appropriate actions for contaminants not subject to any national primary drinking water regulation".

As its title indicates, this Advisory includes consumer acceptability advice as "appropriate" under this statutory provision, as well as a health effects analysis.

### What is MtBE?

MtBE is a volatile, organic chemical. Since the late 1970's, MtBE has been used as an octane enhancer in gasoline. Because it promotes more complete burning of gasoline, thereby reducing carbon monoxide and ozone levels, it is commonly used as a gasoline additive in localities which do not meet the National Ambient Air Quality Standards.

In the Clean Air Act of 1990 (Act), Congress mandated the use of reformulated gasoline (RFG) in areas of the country with the worst ozone or smog problems. RFG must meet certain technical specifications set forth in the Act, including a specific oxygen content. Ethanol and MtBE are the primary oxygenates used to meet the oxygen content requirement. MtBE is used in about 84% of RFG supplies. Currently, 32 areas in a total of 18 states are participating in the RFG program, and RFG accounts for about 30% of gasoline nationwide.

Studies identify significant air quality and public health benefits that directly result from the use of fuels oxygenated with MtBE, ethanol or other chemicals. The refiners' 1995/96 fuel data submitted to EPA indicate that the national emissions benefits exceeded those required. The 1996 Air Quality Trends Report shows that toxic air pollutants declined significantly between 1994 and 1995. Early analysis indicates this progress may be attributable to the use of RFG. Starting in the year 2000, required emission reductions are substantially greater, at about 27% for volatile organic compounds, 22% for toxic air pollutants, and 7% for nitrogen oxides.

### Why is MtBE a Drinking Water Concern?

A limited number of instances of significant contamination of drinking water with MtBE have occurred due to leaks from underground and

above ground petroleum storage tank systems and pipelines. Due to its small molecular size and solubility in water, MtBE moves rapidly into groundwater, faster than do other constituents of gasoline. Public and private wells have been contaminated in this manner. Non-point sources, such as recreational watercraft, are most likely to be the cause of small amounts of contamination in a large number of shallow aquifers and surface waters. Air deposition through precipitation of industrial or vehicular emissions may also contribute to surface water contamination. The extent of any potential for build-up in the environment from such deposition is uncertain.

### **Is MtBE in Drinking Water Harmful?**

Based on the limited sampling data currently available, most concentrations at which MtBE has been found in drinking water sources are unlikely to cause adverse health effects. However, EPA is continuing to evaluate the available information and is doing additional research to seek more definitive estimates of potential risks to humans from drinking water.

There are no data on the effects on humans of drinking MtBE-contaminated water. In laboratory tests on animals, cancer and noncancer effects occur at high levels of exposure. These tests were conducted by inhalation exposure or by introducing the chemical in oil directly to the stomach. The tests support a concern for potential human hazard. Because the animals were not exposed through drinking water, there are significant uncertainties about the degree of risk associated with human exposure to low concentrations typically found in drinking water.

### **How Can People be Protected?**

MtBE has a very unpleasant taste and odor, and these properties can make contaminated drinking water unacceptable to the public. This Advisory recommends control levels for taste and odor acceptability that will also protect against potential health effects.

Studies have been conducted on the concentrations of MtBE in drinking water at which individuals can detect the odor or taste of the chemical. Humans vary widely in the concentrations they are able to detect. Some who are sensitive can detect very low concentrations, others do not taste or smell the chemical even at much higher concentrations. Moreover, the presence or absence of other

natural or water treatment chemicals can mask or reveal the taste or odor effects.

Studies to date have not been extensive enough to completely describe the extent of this variability, or to establish a population threshold of response. Nevertheless, we conclude from the available studies that keeping concentrations in the range of 20 to 40 micrograms per liter ( $\mu\text{g/L}$ ) of water or below will likely avert unpleasant taste and odor effects, recognizing that some people may detect the chemical below this.

Concentrations in the range of 20 to 40  $\mu\text{g/L}$  are about 20,000 to 100,000 (or more) times lower than the range of exposure levels in which cancer or noncancer effects were observed in rodent tests. This margin of exposure is in the range of margins of exposure typically provided to protect against cancer effects by the National Primary Drinking Water Standards under the Federal Safe Drinking Water Act. This margin is greater than such standards typically provided to protect against noncancer effects. Thus, protection of the water source from unpleasant taste and odor as recommended will also protect consumers from potential health effects.

EPA also notes that occurrences of ground water contamination observed at or above this 20-40  $\mu\text{g/l}$  taste and odor threshold -- that is, contamination at levels which may create consumer acceptability problems for water suppliers -- have to date resulted from leaks in petroleum storage tanks or pipelines, not from other sources.

### **What is Being Done About the Problem?**

#### **Research**

The EPA, other federal and state agencies, and private entities are conducting research and developing a strategy for future research on all health and environmental issues associated with the use of oxygenates. To address the research needs associated with oxygenates in water, a public, scientific workshop to review the EPA's Research Strategy for Oxygenates in Water document was held on October 7, 1997.

Discussions included current, or soon to be started, oxygenate projects in the areas of environmental monitoring/occurrence, source characterization, transport and fate, exposure, toxicity, remediation, among others. The identified research will help provide the

necessary information to better understand the health effects related to MtBE and other oxygenates in water, to further our knowledge on remediation techniques, and to direct future research planning towards the areas of highest priority. This document is expected to be available for external review by January, 1998. EPA plans to hold a workshop with industry to secure commitments on conducting the needed research in the Spring of 1998.

The EPA has also recently notified a consortium of fuel and fuel additive manufacturers of further air-related research requirements of industry under section 211(b) of the Clean Air Act (CAA). The proposed animal inhalation research focuses on the short and long term inhalation effects of conventional gasoline and MtBE gasoline in the areas of neurotoxicity, immunotoxicity, reproductive and developmental toxicity, and carcinogenicity. The testing requirements will also include an extensive array of human exposure research. This research will be completed at varying intervals over the next five years and could be very useful for assessing risks from MtBE in water, depending on the outcome of studies underway on the extrapolation of inhalation risks to oral ingestion.

When adequate research on the human health effects associated with ingestion of oxygenates becomes available, the EPA Office of Water will issue a final health advisory to replace the present advisory.

### **Monitoring**

The EPA's Office of Water has also entered into a cooperative agreement with the United States Geological Survey (USGS) to conduct an assessment of the occurrence and distribution of MtBE in the 12 mid-Atlantic and Northeastern states. Like California, these States have used MtBE extensively in the RFG and Oxygenated Fuels programs. This study will supplement the data gathered in California and will attempt to shed light on the important issues of (1) whether or not MtBE has entered drinking water distribution systems or impacted drinking water source supplies, and (2) determine if point (land) or nonpoint sources (air) are associated with detections of MtBE in ground water resources. Activities are underway to begin collecting data in early 1998.

### **Underground Storage Tanks**

Under EPA regulations, leaks from underground storage tank systems (USTs) which may cause

contamination of groundwater with MtBE or other materials are required to be reported to the "implementing agency" which, in most cases, is a state agency. The EPA Office of Underground Storage Tanks and State and local authorities are addressing the cleanup of water contaminated by such leaks. All USTs installed after December 1988 have been required to meet EPA regulations for preventing leaks and spills. All USTs that were installed prior to December 1988 must be upgraded, replaced, or closed to meet these requirements by December 1998.

### **Safe Drinking Water Act Candidate List**

The Safe Drinking Water Act (SDWA), as amended in 1996, requires EPA to publish a list of contaminants that may require regulation, based on their known or anticipated occurrence in public drinking water systems. The SDWA, as amended, specifically directs EPA to publish the first list of contaminants (Contaminant Candidate List, or CCL) by February 1998, after consultation with the scientific community, including EPA's Science Advisory Board, and after notice and opportunity for public comment. The amendments also require EPA to select at least five contaminants from the final CCL and make a determination of whether or not to develop regulations, including drinking water standards, for them by 2001. The EPA Office of Water published a draft CCL for public comment in the Federal Register on October 6, 1997 (62 FR 52194). MtBE is included on the draft CCL based on actual MtBE contamination of certain drinking water supplies, e.g., Santa Monica, and the potential for contamination of other drinking water supplies in areas of the country where MtBE is used in high levels.

### **How Can I Get My Water Tested?**

A list of local laboratories that can test your water for MtBE can be obtained from your state drinking water agency. The cost for testing is approximately \$150 per sample. The analysis should be performed by a laboratory certified to perform EPA certified methods. The laboratory should follow EPA Method 524.2 (gas chromatography/mass spectrometry).

### **How Can I Get Rid of MtBE If It's In My Water?**

In most cases it is difficult and expensive for individual home owners to treat their own water. Any detection of MtBE should be reported to

your local water authority, who can work with you to have your water tested and treated.

**Are There Any Recommendations for State or Public Water Suppliers?**

Public water systems that conduct routine monitoring for volatile organic chemicals can test for MtBE at little additional cost, and some States are already moving in this direction.

Public water systems detecting MtBE in their source water at problematic concentrations can remove MtBE from water using the same conventional treatment techniques that are used to clean up other contaminants originating from gasoline releases, such as air stripping and granular activated carbon (GAC). However, because MtBE is more soluble in water and more resistant to biodegradation than other chemical constituents in gasoline, air stripping and GAC treatment requires additional optimization and must often be used together to remove MtBE effectively from water. The costs of removing MtBE will be higher than when treating for gasoline releases that do not contain MtBE. Oxidization of MtBE using UV/peroxide/ozone treatment may also be feasible, but typically has higher capital and operating costs than air stripping and GAC.

**To Obtain the Advisory:**

Call the National Center for Environmental Publications and Information (NCEPI) at 1-800-490-9198 to be sent a copy or write to NCEPI, EPA Publications Clearinghouse, P.O. Box 42419, Cincinnati, OH 45242 .

Internet download:  
[www.epa.gov/OST/Tools/MtBEaa.pdf](http://www.epa.gov/OST/Tools/MtBEaa.pdf)

**To Obtain the Research Strategy on Oxygenates in Water, External Review**

**Draft, Contact:** Diane Ray, U.S. EPA, Office of Research and Development, NCEA, MD-52, RTP, NC 27711 or by phone (919)541-3637.

Internet download:  
[www.epa.gov/ncea/oxywater.htm](http://www.epa.gov/ncea/oxywater.htm)

**To Obtain the 211(b) Air-Related Research Requirements, Contact:**

John Brophy, U.S. EPA, Office of Air and Radiation; phone (202) 564-9068;  
[www.epa.gov/omswww/omsfuels.htm](http://www.epa.gov/omswww/omsfuels.htm)

**For Further Information on the Advisory , Contact:**

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**For Further Information on the Research Strategy, Contact:**

Diane Ray, U.S. EPA, Office of Research and Development, NCEA, MD-52, RTP, NC 27711  
or by phone (919)541-3637.



# VIII Lake Code Designation

Laboratory Reports are provided in the previous sections.

Sample ID is “XX-YY-ZZ” where

XX designation:

BB for Black Butte

EA for Eastman

EN for Englebright

HE for Hensley

IS for Isabella

KA for Kaweah

ME for Mendocino

MC for Martis Creek

NH for New Hogan

PF for Pine Flat

SO for Sonoma

SU for Success

YY designation

SP for Spring

SU for Summer

ZZ designation

S for surface of Lake

B for bottom of Lake

I-1 for inflow 1

I-2 for inflow 2

O for outflow

Example: BB-SU-S is for a water sample taken from Black Butte in the Summer on the Lake's Surface.